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ABSTRACT

This document contains 36 programs and/or material listings that were nominated by at least three persons and for which there was evidence of the quality of the program or materials. Reviewers looked for positive evaluation data on the impact of the materials on students, or other information that assessed the quality of the program or materials, or both. This resulted in a selected listing of programs and materials. Print and/or nonprint materials for students' use also had to be available. Programs and materials are listed in four sections: Elementary-Secondary (K-12), Elementary (K-8), Junior High/Middle School, and Secondary (7-12). One college program, which could also be used with high school students in a second-level science course, is also included. A final section provides some comments relative to the variety of programs and materials identified as a results of this project. Topics include physical science, engineering, life sciences/health, computers, physics, telecommunications, marine biology, environmental education, ecosystems, geography, technology, scientific inquiry, water quality, earth science, field trips, and problem solving. Nine resource organizations and 26 references are listed. (KR)

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Office of Educational Research and Improvement
EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)

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PROMISING AND EXEMPLARY PROGRAMS AND MATERIALS IN ELEMENTARY AND SECONDARY SCHOOLS - SCIENCE

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December 1990

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SCIENCE EDUCATION INFORMATION REPORT

THE ERIC SCIENCE, MATHEMATICS AND ENVIRONMENTAL EDUCATION CLEARINGHOUSE
in cooperation with
The Office of Educational Research and Improvement, U.S. Department of Education
and
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SE 052 236

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PROMISING AND EXEMPLARY PROGRAMS AND MATERIALS FOR ELEMENTARY AND SECONDARY SCHOOLS - SCIENCE

Introduction

Many school staff and their client communities are concerned about pupil achievement, skills, and attitudes related to science. To respond to these concerns, staff need to determine how they can improve their science programs by modifying the content and skills emphasized in the curriculum, changing or supplementing instructional materials, changing instructional approaches, and changing the use of technology.

What should be included in an elementary and secondary school science program?

There are several publications available to use to determine what a science program should include. Several states including California, Michigan, and New York have produced state guides or frameworks suggesting what should be included in a good elementary school science program.

The American Association for the Advancement of Science (AAAS) has launched Project 2061, an ambitious project outlining content to be included in K-12 school programs. The National Science Teachers Association (NSTA) is developing a project to modify the scope and sequence of K-12 science.

In addition to the state and national frameworks there are guidelines for elementary school science produced by other groups including the National Center for Improving Science Education (1989).

What materials are available that have been evaluated for their impact on student performance?

The National Diffusion Network (NDN)

The NDN provides funds to disseminate exemplary programs and materials. Before a program can be included in the NDN program, it must be approved by a review group, the Program Effectiveness Panel. A program requesting a review must provide evaluation data that indicate the program was effective in the school in which it was developed or field tested and that it could be used successfully in other schools.

Programs or materials that are judged effective are summarized in the Department of Education publication *Education Programs That Work* (Education Programs..., 1988); updated editions are produced periodically. Elementary science programs in *Science Education Programs That Work*, (1989) include "Conservation for Children," "Ecology," "Foundational Approaches in Science Teaching (FAST)," "Hands-on Elementary Science," "Informal Science Study (IFSS)," "Life Lab Science Program," "Marine Science Project: for SEA," "Starwalk," and "ZOO."

Secondary science programs in the most recent edition *Science Education Programs That Work*, (1989) include "Environment and Technology Project, "Geology Is," "Informal Science Study (IFSS)," Marine Science Project: For SEA," "The Mechanical Universe," "Physics--Teach to Learn," "PRISMS: Physics Resources and Instructional Materials," "Science-Technology-Society: Preparing for Tomorrow's World," "Sci-Math," "Stones and Bones," and "WIZE: Wildlife Inquiry Through Zoo Education.

The National Science Foundation (NSF)

The National Science Foundation is providing support for the development of several elementary and middle school programs. All materials developed go through trials with pupils before they are released for use by schools. Among the projects being supported are the following: (1) The Life Lab Science Program, a cooperative effort of Life Lab Science Program, Inc. and Addison-Wesley Publishing Company; (2) The Science Connection, a cooperative project of the Houston Museum of Natural Science and Silver, Burdett and Ginn Publishing Company; (3) Super Science: A Mass Media Program, a cooperative effort of Scholastic, Inc. and several school districts: (4) Full Option Science System (FOSS), a cooperative project of the Lawrence Hall of Science and Ohaus Scale Corporation; (5) National Geographic Kids Network Project, a cooperative project of the Technical Education Research Center, Inc. and the National Geographic Society; (6) Science for Life and Living: Integrating Science, Technology, and Health, a cooperative project of the Biological Sciences Curriculum Study, Kendall/Hunt Publishing Company, and others; and (7) Improving Urban Elementary Science: A Collaborative Approach, a cooperative activity of the Education Development Center, Inc. and six cities. The middle school program, Science Quest, is being produced at Florida State University in cooperation with Houghton Mifflin.

The National Science Foundation also continues to provide support for secondary school science programs and materials. Projects supported include physics, chemistry, biology, health sciences, and earth sciences. *The Directory of Awards* (1989) lists many of the current activities. Additional projects are also being supported.

What are other sources of programs and materials with evaluation data?

The Educational Products Information Exchange (EPIE) is a nonprofit organization that reviews and evaluates educational materials. EPIE produces a newsletter and special publications that include evaluation information on a variety of curriculum materials including science. A listing of EPIE materials can be obtained by writing to EPIE.

Some of the Regional Educational Laboratories sponsored by the U.S. Department of Education produce and/or review science materials. The Northwest Regional Educational Laboratory, for example, reviews and evaluates computer software, including those related to science. They publish the results of their reviews on a regular basis.

States such as New York produce science materials for schools that have had extensive evaluation. Some states such as California and Texas publish reviews of textbooks.

The ERIC database contains materials, descriptions of programs, and evaluation data related to many programs.

What are sources of information about promising programs and materials?

Some programs and materials have been found to be effective for improving learning, but have not been reviewed on a formal basis by an outside organization or agency. Based on their use and the reported results, they are considered promising programs and materials and worthy of consideration by others.

The COSMOS Corporation (White, 1986) worked with the National Science Teachers Association and other groups to identify programs and materials that were considered effective. The catalog published in 1986 contains more than 40 descriptions of programs, materials, and practices for elementary school science.

The Title II program of the Education for Economic Security Act has supported the development of promising programs and materials. A recent document published by the United States Department of Education contains over 80 project summaries from projects funded in 39 states and the District of Columbia (Exemplary Projects. Mathematics-Science..., 1988). The subject areas covered in these projects include several elementary and secondary school science projects.

Elementary and Secondary school science programs and materials are also being developed with funds from the U.S. Department of Education Eisenhower Act. *The Abstracts of the 1989 and 1988 Awards: Dwight D. Eisenhower Mathematics and Science National Programs* (Levinson, 1989) include elementary programs as well as secondary programs with science components.

The National Science Teachers Association (NSTA) inaugurated the Search for Excellence in Science Education in 1982 to carry out the National Science Foundation's 1981 initiative, Project Synthesis. A committee established criteria for excellence and applied them to actual science programs.

Twelve elementary school science programs were identified and described in Volume 1, Number 2 of the Focus on Excellence series (Penick, 1983). Additional programs have been identified and described in other publications. Middle school programs were identified in a 1985 NSTA publication edited by Penick and Krajcik.

Eight issues in the Focus on Excellence series describe promising secondary school programs: *Biology* (Penick and Bonstetter, 1984); *Science/Technology/ Society* (Penick and Meinhard-Pellens, 1984); *Physics* (Penick, 1985); *Middle School/Junior High Science* (Penick and Krajcik, 1985); *Chemistry* (Penick, 1985); *Earth Science* (Penick, 1986); *Energy Education* (Glass, 1985); and *Exemplary Programs in Physics, Biology and Earth Science* (Yager, 1984).

There are a variety of programs and materials available that make use of new technology. Software has been and is being developed for elementary school programs. Integrated learning systems have been developed for elementary and secondary school science. Distance learning programs (including the STAR School Project) also include materials for elementary school science education. *Linking for Learning* and *Online: Computers in Education* describe several examples.

What is the ERIC/SMEAC Promising and Exemplary Programs and Materials Identification Project?

Based on requests received from school personnel for the identification of promising and exemplary program materials, the ERIC Clearinghouse for Science, Mathematics, and Environmental Education (ERIC/SMEAC) has contacted (1) state, county, and local coordinators and curriculum specialists for science and (2) federal program staff for nominations of programs and materials they consider promising and exemplary. In addition, association programs, newsletters, journals, and materials received at ERIC/SMEAC have been reviewed for information on programs and materials.

Information relating to programs and materials that were nominated was reviewed. When additional information was needed regarding either the program or the materials, ERIC/SMEAC staff contacted the producers and/or users of the materials to obtain further information.

This document contains 36 programs and/or material listings that were nominated by at least three persons and for which there was evidence of the quality of the program or materials. Reviewers looked for positive evaluation data on the impact of the materials on students, or other information that assessed the quality of the program or materials, or both. This resulted in a selected listing of programs

and materials. Print and/or nonprint materials for students' use also had to be available.

Programs and materials are listed in the four sections: (1) Elementary-Secondary (K-12), (2) Elementary (K-8), (3) Junior High /Middle School, and (4) Secondary (7-12). One college program, that could also be used with high school students in a second-level science course, is also included. A final section provides some comments relative to the variety of programs and materials identified as a result of this project.

Programs and materials included in the National Diffusion Network (NDN) are not relisted in our lists; though they would qualify based on our criteria. Consult the NDN directory for information on these items.

Identification of promising and exemplary programs and materials is a continuing effort. We invite nominations that include descriptions of the programs and materials, as well as the actual materials. Contact ERIC/SMEAC for nomination forms and further information.

Selected Promising and Exemplary Materials and Programs for K-12

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Science Activities for the Visually Impaired/Science Enrichment for Learners with Physical Handicaps (SAVI/SELPH) 15
Project WILD 17

TITLE OF PROGRAM:

Great Explorations in Math and Science (GEMS)

SOURCE(S):

Lawrence Hall of Science
University of California
Berkeley, CA 94618

AUDIENCE:

Preschool to Grade 10. Can be augmented through grade 12.

PROGRAM DESCRIPTION:

The purpose of the Great Explorations in Math and Science (GEMS) program is to produce and publish activity guides in science and mathematics for all levels from preschool to Grade 12. The activities are designed to be used by teachers who have little or no background in science or mathematics and are activity-based, hands-on, discovery-oriented. Materials needed for the activities are inexpensive and easy to obtain locally. A workshop of 1-1/2 to 3 hours is available for inservice teachers, along with a summer institute of one month duration.

PRODUCTION DATE: 1985.

EVALUATION AND/OR COMMENTS:

Approximately 2000 teachers are currently using the guides. Identified as a Program of Excellence by the Sharing Success in Florida program.

MATERIALS AVAILABLE:

Teachers Guides

Acid Rain (8 sessions, Grades 6-10)—This unit combines scientific inquiry and critical thinking skills as students learn about acids and the pH scale, make "fake lakes" and determine how the pH changes after an acid rainstorm, present a play focusing on the effects of acid rain on aquatic life, and hold a town meeting to discuss possible solutions to the problem of acid rain; they also experiment to determine the effect of various dilutions of acid on seed germination.

Animal Defenses (2 sessions, Grades Preschool-K)—In this activity, the children add defensive structures to an imaginary defenseless animal.

Animals in Action (5 sessions, Grades 6-9)—While observing animals in a large classroom corral, the class experiments by changing the corral environment and adding different stimuli. Then teams of students generate hypotheses, conduct experiments, and hold a scientific convention to discuss their findings.

Bubble-ology (10 sessions, Grades 5-9)—Students devise an ideal bubble-blowing instrument; test dishwashing brands to see which makes the biggest bubbles; determine the amount of glycerin needed for the biggest bubbles; employ the Bernoulli principle to keep bubbles aloft; use color patterns to determine when bubbles will pop; and create bubbles that will last for days.

Buzzing a Hive (10 sessions, Grades Preschool-3)—Students learn about the complex social behavior, communication, and hive environment of the honey bee by making paper bees, a bee hive, flowers with pollen, and bee predators.

Chemical Reactions (3 sessions, Grades 6-10)—An ordinary ziplock bag becomes a safe laboratory, as students mix chemicals that bubble, change color, get hot, and produce gas, heat, and an odor. They experiment to determine what causes heat in this chemical reaction.

Color Analyzers (4 sessions, Grades 5-8)—Students investigate light and color while experimenting with diffraction gratings and color filters. They use color filters to decipher secret messages, then create their own secret messages. A class set of red and green filters and diffraction gratings is included.

Convection: A Current Event (4 sessions, Grades 6-9)—Students explore this important physical phenomenon by observing and charting the convection currents in a liquid. They then explore convection in air and generalize their patterns to wind. Convection is also related to other ways that heat moves and to the movement of magma inside the earth.

Crime Lab Chemistry (2 sessions, Grades 4-8)—Challenged to learn which of several black pens was used to write a ransom note, students learn and use the chemical technique of paper chromatography.

Discovering Density (4 sessions, Grades 6-10)—Students attempt to layer various liquids in a straw, leading them to explore the concept of density for themselves. The teacher then introduces the formula for determining density.

Earth, Moon, and Stars (15 sessions, Grades 5-9)—Students investigate ancient models of the world, earth's shape, gravity, the moon and its phases, star clocks, and star maps. The activities about the earth, moon, and stars help students learn about astronomy and include observing and recording changes in the sky and creating models to help explain observations.

Earthworms (3 sessions, Grades 6-10)—Students observe and record the pulse rates of earthworms. They experiment to discover the responses of earthworms to different temperatures, and graph the results.

Experimenting With Model Rockets (7 sessions, Grades 6-10)—The process of controlled experimentation is introduced in this series of rocketry activities. Students experiment to see what factors influence how high a model rocket will fly by varying the number and placement of fins or the length of the body. Safety and teamwork are stressed. Because students use Height-O-Meters to measure rocket altitudes, it is necessary to complete that GEMS unit before doing these rocketry activities.

Fingerprinting (3 sessions, Grades 4-8)—The fingers-on activities in this unit allow students to explore the similarities and variations of fingerprinting. Students take their own fingerprints and apply classification skills to solve a crime.

Global Warming and The Greenhouse Effect (8 sessions, Grades 7-10)—Students explore this controversial topic by building a "greenhouse model" of the atmosphere, playing a "greenhouse simulation game," and comparing the amounts of carbon dioxide in car exhaust, human breath, air, and the gas created by the reaction of baking soda with vinegar.

Height-O-Meters (4 sessions, Grades 5-10)—Students are introduced to the principle of triangulation by making simple cardboard devices called Height-O-Meters. Students measure angles to determine the height of the school flagpole, and compare how high a styrofoam and rubber ball can be thrown. Going further activities relate triangulation to the real-life activities of forest rangers and astronomers.

Hide a Butterfly (3 sessions, Grades Preschool-3)—The children create a large mural of a meadow in blossom, make paper butterflies and bird puppets to enact "The Butterfly Play," and learn about protective coloration.

Hot Water & Warm Homes From Sunlight (5 sessions, Grades 4-8)—Students build houses and hot water heaters to discover more about solar power. They conduct experiments to determine the effects of size, color, and number of windows on the amount of heat produced from sunlight.

Involving Dissolving (4 sessions, Grades 1-3)—Students learn about the concepts of dissolving, evaporation, and crystallization. Using familiar substances, they create homemade "gel-o," colorful disks, and crystals that emerge on black paper to make a "starry night."

Liquid Explorations (7 sessions, Grades K-3)—In this series of activities, students explore the properties of liquids; they play a classification game, observe how food coloring moves through different liquids, then create secret salad dressing recipes and an "ocean in a bottle."

Mapping Animal Movements (4 sessions, Grades 5-9)—Students apply field biology techniques, using a sampling and mapping system to quantify and compare the movements of hamsters and crickets. Students plan and conduct experiments, graphing changes in movement patterns when food and shelter are added to the environment.

Mapping Fish Habitats (4 sessions, Grades 6-10)—Students learn about and apply the field mapping techniques of aquatic biologists as they chart the movements of fish in a classroom aquarium. Students plan experiments to determine the effects of an environmental change on the home ranges of the fish.

More Than Magnifiers (4 sessions, Grades 6-9)—In a series of four activities, using the same two lenses, students find out how lenses are used in magnifiers, simple cameras, telescopes, and slide projectors. They learn that lenses have certain measurable properties that can help determine which lenses are best for specific purposes. Class sets of lenses are available for purchase from the GEMS project.

Of Cabbages and Chemistry (4 sessions, Grades 4-8)—This series of activities offers students a chance to explore acids and bases using the special indicator properties of red cabbages. Students discover that chemicals can be grouped by behaviors, and relate acids and bases to their own daily experience.

Oobleck: What do Scientists do? (5 sessions, Grades 4-8)—Students investigate and analyze the properties of a strange green substance named "Oobleck," said to come from another planet. The class holds a scientific convention to critically discuss experimental findings and design a space craft to land on an ocean in "Oobleck."

Paper Towel Testing (4 sessions, Grades 5-8)—In a series of experiments, the students rank the wet strength of absorbency of four brands of paper towels. Based on their findings and the cost of each brand, they determine which is the "best buy." These activities provide a stimulating introduction to both consumer science and the concept of controlled experimentation.

River Cutters (3-6 sessions, Grades 6-9)—This unit presents students with a unique way to collapse geological time in a model river system, using diatomaceous earth. Students create rivers, observing and recording their results. They acquire geological terminology and begin to understand rivers as

dynamic, ever-changing systems. The concepts of erosion, pollution, and human manipulation of rivers are introduced.

Vitamin C Testing (4 sessions, Grades 4-8)—This activity provides a stimulating introduction to chemistry and nutrition. Students perform a simple chemical test using a vitamin C indicator to compare the vitamin C content of different juices and graph results. Older students can examine the effects of heat and freezing on vitamin C content.

QUADICE (5 sessions, Grades 4-8)—This mathematical game encourages students to perform mental calculations, handle fractions with greater confidence, and explore probability.

Assembly Presenter's Guides

The "Magic" of Electricity
Solids, Liquids, and Gases

Exhibit Guides

Shapes, Loops & Images
The Wizard's Lab

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TITLE OF PROGRAM:

The Infinite Voyage

SOURCE(S):

WQED
Pittsburgh, PA

AUDIENCE:

K-12

PROGRAM DESCRIPTION:

The Infinite Voyage is a series of hour-long television special programs featuring scientists who are pushing beyond the frontiers of knowledge. Now in its fourth season on PBS, this critically acclaimed series continues to raise student awareness of science and technology and spark curiosity. A teaching guide is produced for each special, offering useful information which teachers may incorporate into the classroom.

PRODUCTION DATE: 1987.

EVALUATION AND/OR COMMENTS:

Winner of the Silver Award for Series, The Houston International Film Festival, 1989; co-winner for Series in Public Relation Campaign, Matrix Awards/Women in Communication, 1989; Special Jury Award for Series, Houston International Film Festival, 1989; finalist for Series, Birmingham International Educational Film Festival, 1987. Winner of the Gold Award, John Muir Medical Film Festival, 1989 and the Gold Award, Broadcast Design Association, 1989 for *The Champion Within*. Winner of the Golden Eagle Award, Cline Award, 1989; the Bronze Award, Broadcast Design Association, 1989; the Electra Certificate Award, Birmingham International Educational Film Festival, 1989; and the Bronze Plaque, Film Council of Greater Columbus, 1989 for *Crisis in the Atmosphere*. Winner of the Gold Award, Broadcast Design Association, 1989 for *The Future of the Past*. Winner of the Gold Award, Broadcast Design Association, 1989; the President's Award, Film Council of Greater Columbus, 1989; and the Chris Award, Film Council of Greater Columbus, 1989 for *The Living Clock*. Banff Finalist, 1989; cited for Excellence in Broadcast Journalism, American Association for the Advancement of Science, 1988; winner of the Bronze Plaque, Film Council of Greater Columbus, 1988; and Finalist for a National Program/Series, PBS Advertising and Promotional Series, 1988 for *The Great Dinosaur Hunt*. The Eddie Award, American Cinema Editors, 1987, to John Soh and Catherine Shields for *Unseen Worlds*. Emmy, Sound, 1988, to Fred Burnham, Francis Daniel, Marc Gilmartin, Ken King, Lawrence Loewinger, Glen Marullo, David Mathew, Mark Roy for *The Geometry of Life*.

MATERIALS AVAILABLE:

Video series with teacher guides for each program.

<u>Programs</u>

Unseen Worlds—A survey of the technologies used to see the micro-universes of the human body and the macro-universes of other galaxies.

To the Edge of the Earth—Travel with scientists as they explore life in the treetops, on the plateaus of Tibet, in the underwater caves of the Galapagos, and in the Arctic.

The Geometry of Life—An exploration of the explosion of knowledge of genes and DNA, and ways in which genetic engineering might be used to correct congenital diseases.

Fires of the Mind—Scientists use the human mind to understand itself.

Search for Ancient Americans—Archeologists search North America to solve the puzzle of early man's management of his physical world.

The Great Dinosaur Hunt—Were these huge giants of the earth warm-blooded, gregarious, fast-moving creatures. Scientists say that heir theory may be valid.

Life in the Balance—Learn how scientists' new understanding of the complexities of living environments may help in conserving the earth.

Living With Disaster—Scientists help people coexist with natural disasters, such as storms, volcanoes, and earth quakes by learning more about the nature of these catastrophes.

The Champion Within—Can science improve the performance of the human body? Yes. Through advances in sports medicine, Olympic contenders have become gold medal winners, but these benefits are not confined to world-class athletes.

Crisis in the Atmosphere—Scientists recount the ways man has upset the balance in the earth's atmosphere by increased burning of fossil fuel and use of man-made chemicals, and explore ways that may halt the upset or restore the delicate balance in the atmosphere.

Future of the Past—Scientists are working to preserve and restore such wonders as the Parthenon, stained glass windows crafted in the Medieval period, ancient paintings and books, and even cities such as Florence, a work of art in itself. Find out how this partnership between today's scientists and yesterday's artists is saving our natural heritage for the future.

The Living Clock—This special presents the latest data on the mysteries of the internal clocks that regulate biological cycles in each and every organism, including humans.

The Keepers of Eden—Today's new zoos are no longer sterile environments of iron and glass cages. Instead they are microcosms of nature that help scientists save an endangered species.

Sail On, Voyager—This program is a tribute to the only spacecraft to visit four of the other planets in a 12-yerar journey, sending back new data that both enthralled and astonished the people of earth.

Miracles By Design—This special takes viewers on a scientific journey into the world of advance materials, like plastics, artificial skin, and new metals, that are revolutionizing our lives.

CONTACT:

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WQED
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TITLE OF PROGRAM:

Outdoor Biology Instructional Strategies (OBIS)

SOURCE(S):

Developed by W. M. Laetsch and Robert C. Knott at the Lawrence Hall of Science with funding from the National Science Foundation.

AUDIENCE:

Children ages 8-15

PROGRAM DESCRIPTION:

OBIS is an informal science program consisting of 97 titles for children ages 8-15. The activities take students outdoors to schoolyards, backyards, vacant lots, and wilderness areas, to increase their environmental awareness through games, crafts, and experiments. Materials are readily accessible, and lessons are easily conducted by teachers with little science experience.

To aid the user in organizing OBIS activities conceptually and facilitating their use, the OBIS *Ecological Mosaic* was developed. The *Mosaic* is a convenient way for users to select activities by concept, investigative technique, environment, or a combination of the three quickly and conveniently. *Horizontal Axis*: Across the top of the *Mosaic* are listed the eight environments for which the OBIS activities were developed: lawn/grassland, pond, stream, woods, beach, desert, farm/garden, and vacant lot. By scanning the appropriate column, a community leader can select an activity focusing on the appropriate environment. *Vertical Axis*: This axis categorizes the following biological concepts and subclassifications according to which OBIS activities are grouped:

1. Major Structural Patterns in Ecosystems:
   a. Species Diversity
      - Abundance
      - Distribution

   b. Species Dominance
      - Ecological Dominance
      - Esthetic Dominance
      - Economic Dominance

   c. Growth Forms or Life Forms
      - Stratification and Zonation
      - Variation of Forms Within One Population
      - Variation of Forms of Different Populations

2. Major Functional Patterns in Ecosystems:
   a. Food Webs
      - Identification of Trophic Levels
      - Interactions Between Trophic Levels
      - Biogeochemical Cycle

3. Changes in Ecosystems
   a. Periodic Changes
      - Abiotic Changes in Environment
      - Biotic Changes in Environment

b. Successional Changes
- Abundance of Species
- Distribution of Species
- Ecological Dominance
- Identification of Trophic Levels
- Interaction Between Trophic Levels
- Biogeochemical Cycle

c. Natural Selection
- Factors Involved in Natural Selection
- Observed Results of Natural Selection

4. Applied Ecology
a. Identification and Use of Natural Selection

b. Environmental Health

c. Man's Influence on Biohistory

PRODUCTION DATE: 1972.

EVALUATION AND/OR COMMENTS:

A formative evaluation was conducted during the development of OBIS activities to determine: (1) each activity's effectiveness in conveying information and in changing users' attitudes toward the environment; (2) how community group participants and leaders responded to OBIS.

MATERIALS AVAILABLE: Materials needed are easily accessible locally.

Guides

Acorns
Animal Anti-Freeze
Animal Diversity
Animal Movement in Water
Animals in a Grassland
Ants
Attention!
Attract a Fish
Beach Zonation
Beachcombing
Bean Bugs
A Better Fly Trap
Bird Nests
Birdfeeder
Bugs, Worms, and Others
Cactus Wheel
Can Fishing
Cardiac Hill
Clam Hooping
Cool It
Crawdad Crab
Creepers and Climbers
Damsels and Dragons
Desert Hunt
Desert Water Keepers
Envirolopes
Environmental Sun Prints
Flocking to Food
Flower Power
Fly a Leaf
Follow the Scent
Food Chain Game
Food Grab
For the Birds
Gaming in the Outdoors
Great Streamboat Race
Habitats of the Pond
Hold a Hill
Hold It
Hopper Circus
Hopper Herding
How Many Organisms Live Here?
Invent an Animal
Invent a Plant
Isopods
Jay Play
Junk-in-the-Box
Leaf Living
Leapin' Lizards
Lichen Looking
Litter Critters
Logs to Soil
Mapping a Study Site
Metric Capers
Moisture Makers
Mystery Marauders
Night Eyes
Night Shine
OBIS Oil Spill
The Old White Sheet Trick
Out of Control
Pigment Puzzles
Plant Hunt
Plant Patterns
Plants Around a Building
Population Game
Rock Pioneers
Roots and Shoots
Salt Water Revival
Sawing Away
Scent Tracking
Scram or Freeze
Seas in Motion
Seed Dispersal
Sensory Hi-Lo Hunt
Shake It!
Silent Stalking
Snug as a Bug
Sound Off!
Sticklers
Super Soil
Swell Homes
Terrestrial Hi-Lo Hunt
Too Many Mosquitoes
Trail Construction
Trail Impact Study
Tree Tally
Variation Game
Water Breathers
Water Holes to Mini Ponds
Water Snails
Water Striders
Web It
Web Weavers
What Lives Here?
Who Goes There?
Wintergreen

CONTACT:

Dr. Robert C. Knott
Lawrence Hall of Science
University of California
Berkeley, CA 94720
(415) 642-4193

TITLE OF PROGRAM:

Science Activities for the Visually Impaired/Science Enrichment for Learners with Physical Handicaps (SAVI/SELPH)

SOURCE(S):

The SAVI/SELPH program is the combined output of two projects funded by the U.S. Office of Education: Science Activities for the Visually Impaired (SAVI) and Science Enrichment for Learners with Physical Handicaps (SELPH).

AUDIENCE:

Grades 1-10

PROGRAM DESCRIPTION:

SAVI/SELPH is an interdisciplinary, multisensory science enrichment program that has been used effectively with blind and visually impaired students, orthopedically handicapped students, learning disabled students, emotionally handicapped students, hearing impaired students, and nondisabled students as well. The program has been used with students from first through tenth grade, and with every kind of instructor from a volunteer parent to a science specialist, and in varied educational settings, including residential, self-contained, resource, and integrated. The SAVI/SELPH program is composed of three major components: (1) printed activity instructions and other information material for the teacher; (2) student equipment kits; and (3) an educational philosophy for incorporating science into the curriculum of disabled students. Each of the nine modules encompasses a separate content area, and contains four or more activity writeups.

PRODUCTION DATE: 1982.

EVALUATION AND/OR COMMENTS:

SAVI/SELPH materials were used as part of the Science Inservice for Rural California (SIRC) project designed to bring high quality science education programs to Northern California teachers. The SIRC program was recognized as a State of California Title II Exemplary Project, December, 1987.

MATERIALS AVAILABLE:

Kits of supplies and folio guides, and a Leadership Trainer's Manual.

Modules

Communication—consists of four activities in which children learn to identify dropped objects by their sounds. Then, assigning a letter to each sound, they send each other messages by dropping objects in sequence to form words. They experiment with megaphones to find out about amplification, explore the concept of pitch, and experiment with the effects of vibration on pitch. The activities included are: Dropping In, Small Sounds, Big Ears, What's Your Pitch, and Vibration = Sound.

Environmental Energy—contains four activities focusing on energy sources: Solar Water Heater, Sun Power, Blowin' in the Wind, and Wind Power. Students investigate the concepts of active and stored energy and experiment with energy transfer.

Environments—in which students investigate the concept of environment and learn what factors in an organism's environment make it an appropriate place

in which to live. The four activities are: Environmental Plantings, Sea What Grows, Isopods, and The Wanted Weed.

Kitchen Interactions—the four activities in this module provide experiences with common household substances: baking soda, yeast, lemons, salt, and cookies. These somewhat higher-level activities call upon several techniques introduced in other SAVI modules, e.g., controlled experimentation and metric measurement.

Magnetism and Electricity—enables students to investigate the properties of magnets, conduct experiments with electrical circuits, electromagnets, small motors, and telegraphs, and explore the relationship between magnetism and electricity. Activities include: The Force, Making Connections, Current Attractions, and Click It.

Measurement—introduces the metric system through four activities: The First Straw, Take Me to Your Liter, Weight Watching, and The Third Degree. Students learn the importance of standard units of measurement as they investigate length, volume, weight, and temperature of familiar items, using tools that are adapted to the needs of children with visual impairments or other physical handicaps.

Mixtures and Solutions—introduces children to basic chemistry through four sequential activities: Separating Mixtures, Concentrations, Reaching Saturation, and The Fizz Quiz.

Scientific Reasoning—the five activities in this module are designed to help students develop skill in making observations and processing the information they receive from those observations. These activities are concerned with the concepts of variable, and controlled experimentation.

Structures of Life—in which children experiment with living organisms, searching for seeds in familiar fruits and vegetables, using histograms to record data, planting roots, and observing behavioral characteristics of crayfish. The seven activities are: Origin of Seeds, Seed-Grams, The Sprouting Seed, Growing Further, Roots, Meet the Crayfish, and Crayfish at Home.

CONTACT:

Linda DeLucchi or Larry Malone
Center for Multisensory Learning
Lawrence Hall of Science
University of California
Berkeley, CA
(415) 642-8941

TITLE OF PROGRAM:

Project WILD

SOURCE(S):

The founding cosponsors of Project WILD are the Western Regional Environmental Education Council and the Western Association of Fish and Wildlife Agencies. Additional national level sponsors include the American Fisheries Society, Canadian Wildlife Federation, Defenders of Wildlife, U.S. Environmental Protection Agency, National Wildlife Federation, The Wildlife Society, and U.S. Fish and Wildlife Service.

AUDIENCE:

Grades K-12

PROGRAM DESCRIPTION:

Project WILD is an interdisciplinary, supplementary environmental and conservation education program emphasizing wildlife. For instructional purposes in Project WILD, wildlife is defined as any nondomesticated animal. Wildlife may be small organisms only visible to people if seen through a microscope, or as large as a great blue whale. Wildlife includes, but is not limited to, insects, spiders, birds, reptiles, fish, amphibians, and mammals, if nondomesticated. Project WILD is based on the premise that young people and their teachers have a vital interest in learning about the earth as home for people and wildlife. The program emphasizes wildlife—because of its intrinsic, ecological, and other values, as well as its importance as a basis for understanding the fragile grounds upon which all life rests. The goal of Project WILD is to assist learners of any age in developing awareness, knowledge, skills, and commitment to result in informed decisions, responsible behavior, and constructive actions concerning wildlife and the environment upon which all life depends.

PRODUCTION DATE: Primary - 1983; Secondary - 1983; Aquatic - 1987.

EVALUATION AND/OR COMMENTS:

A field test of the Project was conducted in three states, in three demographic areas (urban, suburban, and rural), and across all elementary and secondary grade levels during one full school year. The evaluation involved 259 teachers and more than 6,000 students. The results indicated that Project WILD has definite impact on teachers and students. Students showed significant gains in learning, and developed attitudes toward wildlife that were consistent with the goals of Project WILD. Teachers generally found the activities stimulating and worthwhile in their classes, and were able to integrate them into their curricula. A direct relationship was evidenced between the number of Project WILD instructional activities used by teachers and gains in knowledge and attitudes. Project WILD was effective in urban, suburban, and rural areas. (Flemming, M. Lynette, *Project WILD Evaluation Final Report*. Western Regional Environmental Council, 1983.)

A recent study of Project WILD's use found a random sample of Project WILD workshop participants reporting that 96% of their students have taken action to benefit wildlife and the environment as a result of Project WILD. Examples of action include participating in recycling efforts and creating schoolyard habitat projects.

More than 250,000 educators have participated in Project WILD workshops to date. These educators in turn have reached more than 20 million students using Project WILD materials.

Project WILD has been nominated by several states as an exemplary program.

MATERIALS AVAILABLE:

All Project WILD materials are free to educators who participate in Project WILD workshops.

Aquatic Education Activity Guide (Grades K-12)

This 240 page guide consists of 46 activities that explore the world of water. Children investigate life in aquatic habitats from classroom aquariums to nearby puddles, ponds, or streams. Integrating science with language arts, social studies, and mathematics, the children engage in games, crafts and experiments that demonstrate the complex connections between aquatic organisms and the environments that support them. The activity guide is divided into sections dealing with: (1) awareness and appreciation; (2) diversity of wildlife values; (3) ecological principles; (4) management and conservation; (5) people, culture, and wildlife; (6) trends, issues, and consequences; and (7) responsible human actions. Detailed lesson plans are accompanied by background information, suggestions for classroom management, and ideas for evaluation and extension. The appendices include a variety of references, glossary of terms, the Project WILD conceptual framework, and a list of agencies and organizations that can provide information.

Elementary Activity Guide (Grades K-8)

This 280 page activity guide contains 81 lessons that investigate the biology, behavior, and ecology of animals and their habitats, as well as effects of human actions on the environment. Classroom and outdoor activities integrate science with language arts, mathematics, and social studies as children engage in observations, experiments, crafts, and games that demonstrate the complex relationship between animals and their environment. The lessons are well planned, with helpful background information, advice on classroom management, ideas for extension and evaluation, and suggested resources. The appendices contain a list of agencies and organizations that can provide information; a glossary; a cross listing of activities by grade, by subject, and by skills; a topic index; and the Project conceptual framework.

Secondary Activity Guide (Grades 7-12)

This 288 page activity guide contains 87 lessons that investigate the biology, behavior, and ecology of animals and their habitats, as well as the effects of human actions on the environment. Classroom and outdoor activities integrate science with language arts, mathematics, and social studies as students observe, experiment, and participate in activities which illustrate the complex relationships between animals and their environment. Some of the basic principles on which Project WILD focuses include the following: All things are connected; diversity is natural and important to the health of ecological systems; natural systems are self-regulating; healthy growth in natural systems is optimal, not maximal; change is continuous in natural systems; since every organism has a niche, everyone is important. The instructional activities are organized into four major subject areas: language arts, science, social studies, and mathematics. However, because of the interdisciplinary nature of most of the activities, those using these materials will find that most activities can be used in more than one school subject area. The lessons include helpful background information, ideas for alternative activities, modification suggestions, and suggested resources. The

appendices include a listing of agencies and organizations; a glossary; a listing of activities by grade, subject, and skills; a topic index; and the Project conceptual framework.

CONTACT:

Project WILD
P. O. Box 18060
Boulder, CO 80308-8060
(303) 444-2390

Selected Promising and Exemplary Materials and Programs for K-8

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TITLE OF PROGRAM:

Activities to Integrate Mathematics and Science (AIMS)

SOURCE(S):

AIMS Education Foundation; Fresno Pacific College. An NSF grant in 1982 initiated the project. By 1986, the AIMS Educational Foundation arose as a separate entity.

AUDIENCE:

Grades K-9

PROGRAM DESCRIPTION:

Project AIMS produces curriculum materials that deal with the integration of learning experiences, problem solving activities, and the use of cooperative learning. Designed to supplement the science-mathematics curriculum, these booklets contain activities that provide students with opportunities to explore natural phenomena and develop both mathematical and science skills.

PRODUCTION DATE: 1984.

EVALUATION AND/OR COMMENTS:

The Summer, 1990 workshops attracted an enrollment of 6,615 teachers, a 65% increase over that of 1989. The one-week workshops were offered at 60 sites in 27 states.

MATERIALS AVAILABLE:

Each booklet consists of activities each of which contain student sheets and a teacher's guide.

Booklets:

Down to Earth: Solutions for Math + Science (Grades 5-8) contains 15 investigations of such earth science topics as geology, oceanography, and meteorology.

Fall Into Math and Science (Grades K-1) contains 15 investigations on such topics as weather, food, human growth, plant life, fall holidays, and leaves.

Finding Your Bearings (Grades 4-9) contains activities that integrate geography, mathematics, and science.

Floaters and Sinkers: Solutions for Math and Science (Grades 5-8) includes 26 investigations that demonstrate the concept of density.

From Head to Toe (Grades 5-9) includes studies of the human body, its framework, respiratory system, and circulatory system. The activities focus on measurement and provide an excellent vehicle to build self awareness and establish a basis for a good physical fitness program.

Fun With Foods (Grades 5-8) contains 25 investigations that use food and equipment found in kitchens, supermarkets, or school classrooms to teach and reinforce process skills in math and science.

Glide Into Winter With Math and Science (Grades K-1) contains 16 investigations that employ graphing skills, as children observe, interpret, and record data provided by the happenings of the winter season. Topics include weather, static electricity, growing crystals, nutrition, and the human body.

Hard Hatting in a Geo-World (Grades 3-4) includes 25 investigations relating to geometry, structure, and measurement.

Jawbreakers and Heart Thumpers (Grades 3-4) combines the study of fun foods and body basics.

Math + Science-A Solution (Grades 5-8) presents 25 introductory investigations, sequenced from the simple to the complex according to these science processes: observing and classifying, measuring, estimating, predicting and hypothesizing, controlling variables, gathering and recording data, and applying and generalizing.

Mostly Magnets (Grades 2-8) includes activities in which students learn about the varied behavior of magnets and clarify the attendant concepts.

Our Wonderful World: Solutions for Math + Science (Grades 5-8) contains 19 sequenced investigations in environmental studies covering the following topics: air, water, water transport, soil, plants, animals, and insects.

Out of This World, (Grades 5-9) deals with the solar system and astronomy. Book A concentrates on studies involving the planets and moon.

Overhead and Underfoot (Grades 3,4) includes 15 investigations related to the natural environment. Topics covered include the weather, plants, soil, geology, and conservation.

Pieces and Patterns: A Patchwork in Math and Science (Grades 5-9) includes 19 sequenced investigations on such topics as probability and statistics, turtle graphics, and geometry.

Primarily Bears Book (Grades K-3) contains 16 investigations that include problems in logic, permutations and arrangements, probability and statistics, and measurement and graphing.

Primarily Plants (Grades K-3) contains 22 investigations that cover such concepts as: most plants grow in soil, all plants need water and are affected by temperature, green plants need light, flowers produce seeds that grow into new plants, ferns and mosses are simple green plants, and many kinds of plants have roots, stems, leaves, and flowers.

Primarily Physics (Grades K-3) consists of 32 activities investigating sound, light, and heat energy.

Popping With Power (Grades 3-4) contains activities that deal with energy sources and conservation. Students become machinists, engineers, and electricians as they answer questions related to energy.

Seasoning Math and Science: Spring and Summer (Grade 2) includes 22 investigations related to three main units: Life Sciences, Earth-Space Sciences, and Physical Sciences.

Seasoning Math and Science: Fall and Winter (Grade 2) includes 22 investigations on topics such as holidays, plants, color, weather, and light.

The Sky's the Limit! With Math and Science (Grades 4-8) contains 24 investigations related to the science of aerodynamics.

Soap Films and Bubbles (Grades 4-9) contains activities which allow extensive exploration into the behavior of soap films.

Spring Into Math and Science (Grades K-1) includes 15 investigations on water, solar energy, rainbows, holiday cooking, and chemical reactions.

Water Precious Water (Grades 2-6) contains investigations that relate to water awareness, general process skills, water cycle, evaporation, conservation, treatment, quality absorption and erosion, distribution, and water properties.

Each of the investigations contains a specific lesson plan—including time and materials needed, background information, procedures, discussion questions, and extension. Several reproducible student pages are provided with each investigation. Other booklets are also available.

CONTACT:

AIMS Education Foundation
P.O. Box 8120
Fresno, CA 93747
(209) 255-4094

TITLE OF PROGRAM:

Horizons Plus (The Science Connection)

SOURCE(S):

Developed by Carolyn Summers and Terry Contant of the Houston Museum of Natural Science with support from Silver, Burdett and Ginn, and funding from the National Science Foundation.

AUDIENCE:

Grades 1-6

PROGRAM DESCRIPTION:

This is a supplementary program, designed to be used with the Silver/Burdett basal science textbooks to improve the quality and quantity of science being taught. *A Science Discovery Reader*, for each grade level, introduces concepts within the context of children's experiences. Teacher's editions suggest additional activities and references. *The Science Shoebox Recipe File* contains plans for self-contained, hands-on activities that coordinate with the plot and action of the stories in the reader. *The Science Extension* relates concepts developed in the textbook series and reader to other school disciplines and students' out-of-school environment.

PRODUCTION DATE: 1991.

EVALUATION AND/OR COMMENTS:

This is a National Science Foundation Triad program.

MATERIALS AVAILABLE:

Science Discovery Readers, with teacher's guides; *Science Shoebox Recipe File*, and *Science Extension*.

Ancillary audio and video tapes are also available.

CONTACT:

Silver Burdett & Ginn
Science Product Specialist
4343 Equity Dr.
P. O. Box 2649
Columbus, OH 43216
1-800-848-9500

TITLE OF PROGRAM:

Integrating Science, Math, and Technology (K-6)
(I. Science MaTe Curriculum)

SOURCE(S):

Math/Science Nucleus
Fremont, CA

AUDIENCE:

K-6

PROGRAM DESCRIPTION:

The I. Science MaTe Curriculum and Program is intended for an entire elementary school, integrating and coordinating materials used by all the teachers in the school. In this program, science is treated as a way of thinking, using content materials from the different science disciplines to illustrate underlying themes. The curriculum materials include hands-on activities based on themes for each grade, K-6. The curriculum outlines for each of the six units contain the themes and objectives for each of the six grade levels, the concepts to be learned, brief descriptions of student activities, and a list of career options related to the unit under study. The curriculum was specifically designed for low income area schools, yet is considered to be challenging for students of all income levels. Workshops are conducted throughout the United States and a product showroom is maintained in Fremont, CA that is open to the public.

PRODUCTION DATE: 1990.

EVALUATION AND/OR COMMENTS:

The following persons have implemented the I.Science MaTe curriculum and have received awards for their outstanding efforts toward bettering the quality of science education: Susan Dutcher, McNair Elementary School, Ravenswood City School District, East Palo Alto, CA: Santa Clara County, Kent Award for Exemplary Elementary Program (1988); Arlene Hudson, Menlo Oaks Intermediate School, Ravenswood City School District, East Palo Alto, CA: Santa Clara County, Kent Award for Exemplary Middle School Program (1989); Joyce Blueford, Math/Science Nucleus, Fremont Schools Management Association, Outstanding Friends of Education, 1985, in recognition for Elementary School Science Program at Blacow Elementary, Fremont, CA; Joyce Blueford, U.S. Geological Survey, Federal Employee of the Year Award (Equal Opportunity) 1984 for elementary science program in low-income schools in California; Math/Science Nucleus, Recognition Award, Fremont (CA) Unified (1983-1990) for work done in assisting school district on District School Program.

MATERIALS AVAILABLE:

Teacher manuals and student laboratory guide manuals are available for each of the six units. The total curriculum set includes more than 1500 pages and 700-plus activities. Teachers may duplicate materials for students.

Units

Applied Sciences - Our Technological World (8 weeks, 168 lesson plans)—Themes covered include *Science and Math, Physics, Technology, and Built Environment.* Applied Sciences is all sciences "rolled' into some product or principle that we use everyday in our lives. Students learn by hands-on activities what science is and

how math is very important in any study of science. They learn how the principles of physics are very basic to the technology that we use everyday. Students are also introduced to the effects of technology on our planet.

Universe Cycle - The Search for Our Beginning (4 weeks, 84 lesson plans)—Themes covered include *Universe, Solar System, Earth, and Geography.* Hands-on activities teach students about facts and fantasies of the universe. Students take a closer look at the Earth and its relationship within our solar system. Geographic locations that are used in labs throughout the year are also explored.

Plate Tectonic Cycle - Earth's Moving Force (4 weeks, 84 lesson plans)—Themes covered include *Volcanoes, Earthquakes, Plate Tectonics, and Hazards.* Hands-on activities teach students how scientists investigate the Earth through earthquakes and volcanoes and how to challenge and think about present theories. Learning how to cope with disaster caused by plate tectonics is also emphasized.

Rock Cycle - Understanding The Earth's Crust (6 weeks, 126 lesson plans)—Themes covered include *Chemistry, Minerals, Rocks, and Past Life.* Within the rock cycle, chemistry comes alive as students are taught about the periodic chart and how elements combine to form minerals. Throughout this cycle the importance plate tectonics is emphasized. The remains of past life or fossils preserved in sedimentary rock are used to show how "the present is the key to the past" and why evolution is important in timing of events on Earth.

Water Cycle - The Earth's Gift (4 weeks, 84 lessons plans)—Themes covered include *Water, Oceans, Atmosphere, and Weather.* Students discover the properties of water that make it the perfect liquid for life. We learn about the molecular structure of water and the uniqueness of water, including surface tension, capillary action, density, and other physical properties. Students also learn about how the oceans, atmosphere, and weather are all interrelated.

Life Cycle - Diversity in A Balance (8 weeks, 168 lessons)—Themes covered include *Organisms, Human Biology, Plant Life, and Natural Environment.* Students learn about themselves and their environment. They study tissues, organs and body functions, diseases, and genetics. Hands-on activities include looking at various organisms by determining the different groups of vertebrates and invertebrates. Students learn about plant parts, photosynthesis, the carbon cycle, and why plants are important. The food chain and how it is involved in the natural environment gives students a perspective on how we all interrelate on this planet.

CONTACT:

Joyce Blueford
Math/Science Nucleus
3710 Yale Way
Fremont, CA 94538
(415) 490-6284

TITLE OF PROGRAM:

3-2-1 Contact

SOURCE(S):

Production and presentation of "3-2-1 Contact" was supported by the National Science Foundation, the Department of Education, United Technologies Corporation, The Public Broadcasting System, and the Children's Television Workshop

AUDIENCE:

Elementary, middle school students, especially those children who are not interested in science.

PROGRAM DESCRIPTION:

3-2-1 Contact is a children's television series with three basic goals: (1) To help children experience the joy of scientific exploration and creativity and motivate them to pursue further scientific activities; (2) To help children become familiar with various styles of scientific thinking and to stimulate their thinking skills so that they can learn to analyze important social issues related to science and technology; and (3) To help children—with special appeal to girls and minority children—to recognize science and technology as a cooperative human endeavor open to their participation.

PRODUCTION DATE: 1980.

EVALUATION AND/OR COMMENTS:

A nationwide survey of program preferences involving 4,000 students in the 8-12 year-old target group was conducted. A review of research related to 3-2-1 Contact indicates that children acquired a beginning familiarity with concepts, facts, vocabulary, and relationships presented on Contact. The program appears to have the potential to alter children's stereotype of scientists as older white males who wear white coats and work in laboratories. Some children with more negative feelings were led to new perceptions of the appeal of scientific activities. It was suggested that children with positive leanings toward science found more topics of interest to pursue.

MATERIALS AVAILABLE:

There are three-year taping rights for school use of 3-2-1 Contact. Teacher Guides are available to encourage classroom utilization in Grades 3 through 6. There is also a nationally distributed magazine, 3-2-1 Contact.

CONTACT:

3-2-1 Contact Database, Box TB
Children's Television Workshop
One Lincoln Plaza
New York, NY 10023
(212) 496-5300

TITLE OF PROGRAM:

ScienceQuest

SOURCE(S):

Cheshire (CT) Public Schools

AUDIENCE:

K-6

PROGRAM DESCRIPTION:

Directed by William C. Kyle, Jr., Purdue University; Donna Dvarskas, Cheshire Public Schools; Maria A. Sedotti, University of Connecticut; and Ronald J. Bonstetter, University of Nebraska, this program was developed to enhance students' attitudes toward science. The basic principles underlying program development were that an effective program should be well articulated and coordinated; integrate a balance of science processes and concepts; enhance higher cognitive processes and skills; go beyond the mere possession of information to the application of concepts; and include societal issues. A major concern in the program is staff development that teachers receive in conjunction with program development. A major factor in the success of staff development is the administrative support of such efforts. Delta Science Modules were selected as the focal curricular resources with additional modules and activities selected from L.E.A.F., Project Zoo, and Cuisenaire, and from interactive software such as *Science Toolkit* and *Voyage of the Mimi*. Modules and activities were selected to provide a balance between life science, earth science, and physical science across each grade.

PRODUCTION DATE: 1987.

EVALUATION AND/OR COMMENTS:

After the pilot program's first year, students exhibited significantly enhanced attitudes toward science when compared with their counterparts in control classrooms. Between 50 and 88 percent of the students in the pilot program at any given grade level indicated that science was their first or second favorite subject in school. Only 35 percent of the control group indicated similar preferences. (Kyle, W.C., Jr.; Bonstetter, R.; Sedotti, J. and Dvarskas, D. *Implementing an Effective Elementary Program: The Process of Initiating Change and its Effect on Students' Attitudes*. Paper presented at the Annual Meeting of the National Association for Research in Science Teaching, San Francisco, CA, March 30-April 1, 1989)

The program was the recipient of the 1989 STAR Award.

MATERIALS AVAILABLE:

Units

Kindergarten

Sunshine and Shadows—includes eight activities that introduce children in an organized fashion to some of the characteristics of light. Students investigate the properties of sunshine and shadows in the world around them, learning to observe, manipulate, and identify shadows.

Seasons—helps children learn about themselves and their environments. It focuses on seasonal effects rather than on technical explanations of their causes.

Students take nature walks and observe trees, wild flowers, and grasses; they collect seeds and leaves, and make birdfeeders.

Investigating Water I—consists of nine activities which provide children with opportunities to explore water and discover some of its properties and forms. Children use a variety of tools to mix, pour, measure, and change water. They investigate properties, states of matter, forces of motion, capacity of containers, color mixing, sound, and change over time.

Transitional

Observing an Aquarium—consists of eight activities in which students set up an aquarium and observe water plants and animals in the aquarium. Structure and function of water plants and animals are studied and observations are made of the natural habitat of water plants and animals in a stream or pond.

Investigating Water II—builds upon the concepts started in *Investigating Water I* and consists of 20 activities that involve the use of water. Children make bubbles with various devices, build boats, investigate floating objects, measure water in various containers, observe ice cubes in different shapes and predict changes over time.

Exploration of Magnets—consists of five activities that introduce children to the properties of magnets by the use of hands-on activities.

Grade One

Properties—consists of ten activities that provide children with opportunities to observe and classify familiar objects by properties such as size, shape, color, texture, and weight. They test whether objects float or sink in water and decide on properties that are unique to solids, liquids, and gases.

Fossils and Footprints—focuses on dinosaurs and fossils. Children describe the properties of dinosaurs, learn how to classify each type of dinosaur, learn about the environment that dinosaurs lived in, and learn how to make imprints in plaster. The unit is integrated with math, art, language, arts, and whole language activities.

Seed to Plant—consists of nine activities in which students classify seeds by properties, plant seeds, care for plants, observe and record plant growth, and participate in class projects. The basic plant parts (root, stem, and leaf) and the function of each are introduced.

Grade Two

Weather Watching—consists of six activities to introduce children to the phenomenon of weather and its effect on their lives. Students observe and record weather conditions, measure temperature, and learn to distinguish between conditions from one day to another in comparative terms.

Sink or Float—consists of eight activities that focus on the meaning of buoyancy and density. Students predict which objects will sink or float, build boats and compare the capacities of various shapes of boats and then have boat races.

Classroom Plants—consists of nine activities in which students plant, grow, and care for plants under a variety of conditions in the classroom.

Life Cycle I: Butterflies and Moths—the eleven activities have students observing the growth and development of butterflies through a series of stages: larvae, chrysalides, adults, and the eventual laying of eggs to complete the life

cycle. Students study the response of these organisms to stimuli and learn about their distinguishing characteristics.

Grade Three

Powders & Crystals—composed of nine activities which introduce students to some chemical and physical properties of familiar substances such as baking soda, table salt, citric acid, plaster of Paris, table sugar, and powdered sugar. The chemicals used for tests include iodine and bromthymol blue.

Rocks and Minerals—consists of eight activities that focus on the properties of rocks. Students use a variety of rock and mineral specimens to learn such properties as luster, hardness, and streak.

Our Solar System—consists of four activities that focus on characteristics of our solar system. Students use flashlights and gym balls to experiment with size and position of planets in the solar system, make a solar energy cooker, and make a model solar system with balloons and paper mache'.

Life Cycle I: Eggs and Tadpoles—consists of periodic observations of the development of tadpoles into frogs. Students measure the growth of tadpoles and observe their behavior, and learn what the environment can do to the size of the tadpole by experiments with overcrowding.

Grade Four

Life Cycle III: Behavior of Mealworms—consists of eight activities that focus on the behavior of the mealworm. Students are involved in observing the food-getting behavior of mealworms, observing their behavior in mazes, and experimenting with other aspects of mealworm behavior. Also included in this unit is a focus on the general nature and structure of insects.

Predator/Prey—focuses on the discovery by dissection of what is contained in an owl pellet. Students discover and hypothesize about their findings; reassemble bones to determine what animals the bones are from: and learn about the barn owl and its habitat.

Sound—is composed of ten basic activities that introduce students to sounds made by vibrations, percussion, and wind instruments. They learn to classify sound by volume or by pitch and manipulate variables to alter the pitch of a sound.

Stream Tables—students work with a large stream table to learn about the water cycle, observe what happens when the flow of a river is altered and what stages a river goes through, and learn what glaciers can do to a river by building a glacier.

Grade Five

Electric Circuits—uses materials to make simple circuits, series circuits, and parallel circuits. Students experiment with light bulb brightness in a circuit.

Simple Machines—involves students in making and manipulating simple machines; students measure force, compare work and force, investigate the uses of simple machines and identify variables that affect the performance of the machines.

Astronomy—this unit expands upon the concepts first encountered in the third grade unit, *Our Solar System*. Students do periodic night observations and learn about planets in more detail.

Pond Life—consists of ten activities that introduce the students to correct microscope techniques as the microscopes are used to observe, measure, and classify organisms found in pond habitats. A field trip is made to a pond for observation and collection.

Grade Six

Oceanography—students do year long activities, many of which involve using the video program *Voyage of the Mimi*. Students learn about the flora, fauna, composition, and structure of the ocean and ocean floor. They do activities that involve mapping, navigation, whale anatomy, nature of sound, elements of weather, forecasting weather, structure and function of body systems, and learning survival skills.

CONTACT:

Dr. William C. Kyle, Jr., Director
Mathematics and Science Center
Purdue University
West Lafayette, IN 47907
(317) 494-5889

or

Dr. Donna Dvarskas
Assistant Superintendent of Schools
Department of Education
29 Main St.
Cheshire, CT 06410

TITLE OF PROGRAM:

Up Close & Natural

SOURCE(S):

Produced by New Hampshire Public Television with a grant from the Corporation for Public Broadcasting.

AUDIENCE:

Primary, intermediate

PROGRAM DESCRIPTION:

This series of fifteen 15-minute color video programs is designed to teach children how to look and what to look for in observing wildlife. Television teacher Louise McNamara brings the field and the lakes and forests into the classroom. She helps students in grades one through four sharpen their skills of observation, description, and classification as they increase their sensitivity to and appreciation for the living creatures they see. She encourages viewing children to respond actively to her questions and helps them use their new vocabulary—words that appear on the screen, such as vertebrates, pupa, and herpetologist. The teacher's guide emphasizes tips for safe, ecologically sound nature study and alerts teachers to applicable laws. Follow-up activities link the programs to science, language arts, mathematics, social studies, and art.

PRODUCTION DATE: 1983.

EVALUATION AND/OR COMMENTS:

Winner, Ohio State Award, 1985

MATERIALS AVAILABLE:

Programs

Introduction—Viewers meet a snowy owl and a green darner dragonfly and learn about seasonal changes, habitats, life cycle changes, and differences between living and nonliving things.

Animals Without Backbones—Earthworms, spiders, and crayfish introduce invertebrates.

Insects—Six legs and three body parts: that's an insect. A monarch butterfly's life cycle is contrasted with that of a grasshopper.

Fish—Viewers meet trout, porcupine fish, stingray, flatfish, minnows, and sunfish; see different scales, fins, and gills up close; and learn how different fish behave.

Frogs, Toads, and Salamanders—Viewers see a bullfrog, a leopard frog, and a spotted salamander and learn about the double life of amphibians and how to tell a frog from a toad.

Turtles—Specialized bodies and behavior adapt turtles to many different habitats. Viewers learn the difference between a box turtle and a painted turtle.

Snakes—Both a garter snake and a seven-foot eastern indigo snake have scutes, scales, a hinged jaw, and a one-piece skin. Both benefit humans.

What is a Bird—A pigeon, a great horned owl, loons, and great blue herons illustrate what birds have in common and some special adaptations.

Mammals—A baby raccoon and two fawns introduce the distinctive characteristics of mammals—even dolphins.

Winter at Squam Lake—A snowy owl, some white-tailed deer, and an American black bear show different adaptations to winter's cold.

Life in Winter Forest—Viewers meet the white-footed mouse, gray squirrel, porcupine, opossum, and fisher and see various winter homes in the many-layered forest.

The Pond—Spring brings new life to the pond, including animals too small to see with the naked eye.

Marsh and Swamp—Viewers learn about the food chain and the importance of the wetlands as breeding places for ducks, herons, beavers, and others.

In the Field—A fox kit, woodchuck, opossum, skunk, and kestrel (a swift bird of prey) survive by finding food, seeking shelter, and avoiding danger.

Outside Your Door—Backyard naturalists can study creatures close to home: millipedes, centipedes, spiders, bees, sowbugs, spittle bugs. Nature centers and zoos simulate habitats of exotic animals.

CONTACT:

Agency for Instructional Technology
Box A
Bloomington, IN 47402
1-800-457-4509

Selected Promising and Exemplary Materials and Programs for Jr. High/Middle

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TITLE OF PROGRAM:

The California CLASS Project—Conservation Learning Activities for Science and Social Studies

SOURCE(S):

A 1982 version was originally funded and published by the National Wildlife Federation. Through a grant from the State License Plate Fund, Orange County Office of Education modified the material for California. In addition, the Mobil Foundation and the National Wildlife Federation provided funds for completion.

AUDIENCE:

The program is designed for middle grade students, but can be adapted for both elementary and high school students.

PROGRAM DESCRIPTION:

The CLASS Project was designed to help teachers integrate environmental education with social studies, science, language arts, and mathematics in the middle and junior high school curriculum, using a cooperative learning format and an investigative, hands-on approach to learning in the classroom and on the school grounds. The project includes activities which develop critical thinking skills and an understanding of the science processes necessary for involvement in community conservation projects. The project also provides encouragement and direction for classes to initiate environmental projects in their local areas. Attendance at a workshop of six hours is required to familiarize educators with the CLASS Project and to provide a demonstration of how the materials can be used effectively with the students. Students may receive recognition from the national Wildlife Federation for participating in community projects, thereby becoming part of a nationwide network of CLASS Project Conservation Classrooms.

PRODUCTION DATE: 1986.

EVALUATION AND/OR COMMENTS:

Students from McAuliffe Middle School, Los Alamitos, CA were surveyed after having covered almost one-half of the content. Some student comments are as follows:

> "This class is unique because it gives us time to think about how much our world needs our help. We've been ignoring our world and one person can make a difference." Grace Byun
>
> "Most kids don't know how crummy and polluted our poor planet is. This is an exceptional way to inform the children of the world about the problems they will have to face someday. We'd better change our lifestyles and attitudes before we destroy our future." Amy Woodman
>
> "Many people do not know what's going on in our environment and now I can tell them." Colin Burke
>
> "Since September I've taught almost half of the lessons contained in the CLASS manual to a group of 32 students. The lessons have been consistently outstanding and the student response to the curriculum overwhelmingly positive."...Ann Allen, teacher, McAuliffe Middle School, Los Alamitos, CA

MATERIALS AVAILABLE:

Materials include a notebook containing more than 30 activities for six content areas, a series of case studies, and a resource bibliography. The content areas are: energy use, environmental issues, forest/watershed management, hazardous substances, wetlands, and wildlife habitat management. Each content area includes a section on important background information and content objectives, a set of investigations to explore the topic and to learn management and ecological concepts, a list of optional research projects, and a poster with suggestions for introducing the content area. The case studies are brief descriptions of environmental projects carried out by students around the country. The resource bibliography includes references for the teacher and student, free or inexpensive material from government and private organizations, films, and related educational activities.

CONTACT:

The CLASS Project
Betsy Olson, Coordinator
Environmental Education Grant Program
Math/Science/Environmental Education Unit
P. O. Box 944272
721 Capital Mall
Sacramento, CA 94244-2720
(916) 323-2602

TITLE OF PROGRAM:

The CLASS Project

SOURCE(S):

National Wildlife Federation, with funds from the National Science Foundation.

AUDIENCE:

Educators of middle/junior high school students (Grades 6-9).

PROGRAM DESCRIPTION:

The CLASS Project consists of a series of investigations covering six content areas: Energy Use, Environmental Issues, Forestry/Watershed Management, Hazardous Substances, Wetlands, and Wildlife Habitat Management. (CLASS stands for Conservation Learning Activities for Science and Social Studies.) The investigations are designed as supplemental materials for existing curricula. Activities are as hands-on as possible. Each content area provides several suggestions for possible community action conservation projects. In completing CLASS activities students will acquire knowledge about environmental concepts, use science process skills, and develop an environmental ethic as they use their acquired skills and concepts in taking thoughtful, positive action to protect and enhance the natural environment.

PRODUCTION DATE: 1982.

EVALUATION AND/OR COMMENTS:

The CLASS Project was developed in 1982 and pilot-tested in urban, suburban, and rural classes (grades 6-9) throughout the country. Revisions based on recommendations from field-testing were made. A formal evaluation assessing cognitive and affective outcomes of students was performed to determine program effectiveness. Results showed the CLASS Project instructional materials to be practical, usable, and conceptually sound. In 1988, the California Department of Education and the Orange County Office of Education adapted the original CLASS Project materials to create an expanded version for use in the state of California.

Some comments by educators follow:

"Class uses a variety of study skills and covers environmental issues, which fit well into the school curriculum." Al Stenstrup, Director, Havenswood Environmental Center, Milwaukee, WI.

"Investigation, exploration, and involvement are conducive to middle school education. There are too few EE investigation/infusion guides available, and CLASS fills the niche." Randall Champeau, Associate Professor of Resource Management and Environmental Education, University of Wisconsin, Stevens Point, WI.

The CLASS Project "fits nicely with our state scope and sequence for environmental education, social studies, and science." Craig Chase, Environmental Education Coordinator, Slippery Rock University, Slippery Rock, PA.

MATERIALS AVAILABLE:

The CLASS Project is available in a three-ring, loose-leaf binder. The 134 page document consists of a program overview, the six content areas identified earlier, a series of case studies describing student projects, a resource bibliography, and a

glossary. Each content area contains important background information, a set of investigations in which students explore the topic and learn management and ecological concepts, illustrations,ready-to-copy student worksheets, a list of suggested community action projects, a list of optional research projects, and a full-color poster. All investigations include content objectives, process objectives, and teacher instructions.

CONTACT:

The CLASS Project
School Programs Division
National Wildlife Federation
8925 Leesburg Pike
Vienna, VA 22184-0001
(703) 790-4000
FAX (703) 442-7332

TITLE OF PROGRAM:

Chemical Education for Public Understanding Project (CEPUP)

SOURCE(S):

CEPUP is jointly funded by contributions from industry, private foundations, and the University of California.

AUDIENCE:

Middle and junior high schools students; community groups.

PROGRAM DESCRIPTION:

The Chemical Education for Public Understanding Project (CEPUP) integrates the concepts and processes of chemistry with societal and environmental issues. The project has two components: one is targeted toward middle school and junior high school students, the other centers on community groups. The CEPUP Public Information Center includes a computer-based Chemical Information Center (*CHIC*), which is available to the general public. The goal of CEPUP is to help individuals to learn about chemicals and their use in the environment and to help a scientifically literate citizenry make effective decisions about issues regarding chemicals.

PRODUCTION DATE: 1987.

EVALUATION AND/OR COMMENTS:

The Chemical Education for Public Understanding Program (CEPUP) has been recommended to receive the CMA's "stamp of recognition" as an educational program that will contribute significantly to public understanding of chemicals and chemistry.

MATERIALS AVAILABLE:

Chemical Survey & Solutions and Pollution—What is a chemical? Are chemicals necessary? Is dilution the answer to pollution? Students respond to a questionnaire concerning their perceptions about chemicals. They then apply principles of acid-base chemistry to deal with some of our water pollution problems.

Determining Threshold Limits—How do chemists analyze samples to determine what and how much of a certain chemical is present? Experimentation introduces the concepts of qualitative and quantitative analysis. A simulated animal toxicity experiment introduces the students to the need for, and limitations of, extrapolating animal data to humans.

Investigating Groundwater: The Fruitvale Story—The aquifer feeding the Fruitvale wells is found to be contaminated. This hands-on simulation introduces how the source and extent of the contamination are determined. Students take the roles of community members in trying to decide what to do about it.

Risk Comparison—What are risks to life? Can lifestyle decisions make a difference? Students are introduced to concepts of probability, risk, risk comparison, and decision making.

Toxic Waste: A Teaching Simulation—What is toxic waste? Can hazardous and toxic materials be stabilized and rendered relatively harmless? Students

explore how precipitation, oxidation-reduction, and single replacement reactions can be used in waste reduction and waste treatment processes.

CONTACT:

Herbert D. Thier, Project Director
Lawrence Hall of Science
University of California, CA 94720
(415) 642-8718

TITLE OF PROGRAM;

COMETS Science. Career Oriented Modules to Explore Topics in Science

SOURCE(S):

Development of these materials was funded by the National Science Foundation. Resources provided by the TRW Foundation and the University of Kansas have made reprinting of the publications possible by the National Science Teachers Association.

AUDIENCE:

Grades 5-9

PROGRAM DESCRIPTION:

COMETS Science was developed to demonstrate to early adolescents that learning mathematics and science can have a payoff in a wide variety of careers and to encourage early adolescents, especially girls, to consider science-related careers. The program provides 24 modules to enable teachers to bring into their science or mathematics class community resource people to (1) teach a captivating science lesson; (2) tell students how the science concept is being used in their career; and (3) talk with students and answer questions about their career. In general, each module describes three activities which can be used to follow-up a resource person's visit. Modules are presented in three areas: physical science/engineering; life science/health; and mathematics, calculating and computers.

PRODUCTION DATE: 1982.

EVALUATION AND/OR COMMENTS:

COMETS Science was used as part of TEAMS, an IUPUI program which won an NSTA Exemplary Program award. *COMETS Profiles* received Honorable Mention for the American Educational Research Association Women Educators Curriculum Materials Award in 1984. In an evaluation of the program, it was found that the treatment positively affected students' attitudes toward scientists and toward women in science. (Smith, Walter S. and Thomas Owen Erb. "Effect of Women Science Career Role Models on Early Adolescents' Attitudes Toward Scientists and Women in Science" Journal of Research in Science Teaching , 23 (8): 667-676, 1986)

MATERIALS AVAILABLE:

COMETS Profiles Volume 1—contains 24 biographical sketches of women in scientific professions. Each biography relates to a science topic dealt with in one of the instructional modules of *COMETS Science*. In addition to the biography, each COMETS Profile unit contains follow-up language arts activities which have been written directly to the students, to facilitate their use in learning centers and independent study formats.

Profiles

Coach, Marian Washington
Neonatalist, Valya Visser
Architectural Engineer, Marcia Turner
Chemical Engineer, Marylee Southard
Professor of Computer Science, Sally Sedelow
Nutritionist, Diane Sanders
Mathematician, Judy Roitman
Pharmacist, Marily Rhudy
Installation Foreman, Janice Morgan

Pathologist and Deputy Coroner, Carol Moddrell
Sanitary Engineer, Mary McGhee
Pediatric Psychiatrist, Grace Ketterman
Supervisory Clinical Nurse, Elfrieda Irving
Research Scientist, Geneva Hammaker
Engineer, Donna Geisler
Dentist, Mary Jo Frazier
Geologist, Cynthia Dusel-Bacon
Science Teacher, Joan Duea
Physicist, Gisela Dreschhoff
Mechanical Engineer, Margaret Drake
Physician, Joan Brunfeldt
Athletic Trainer, Sam Booth
Physicians, Sharon & Karan Baucom
Zoo Administrator, Jan Armstrong

COMETS Science Volume II—includes activities that correlate with the career profiles in Volume 1 of this series, *COMETS Profiles*. The guide lists materials and procedures, provides brief biographies and background information on the activities and professions to which they relate, and suggestions for extension. There are also hints on finding resource people in the local community, and inviting them to visit the classroom to enhance activities and discussion of science-related careers.

Topics

Section One: Physical Science and Engineering

A. Construction
   - Forces
   - Simple Machines
   - Center of Gravity

B. Electrically Speaking
   - Electricity
   - Magnetism
   - Energy

C. Energy
   - Energy Production
   - Energy Transfer
   - Energy Conservation

D. Find Some Evidence
   - Chemistry
   - Classification
   - Scientific Method

E. Fluid Follies
   - Water
   - Aquatic Biology
   - Weather

F. Light and Sight
   - Reflection
   - Refraction
   - Eyes

G. Miscellaneous Materials
   - Properties of Matter
   - Metals
   - Rocks

H. Product Improvement
   - Chemistry
   - Properties of Matter
   - Recycling

I. Soil
   - Geology
   - Farmer
   - Land Use Planner

J. Third Dimension
   - Geology
   - Maps and Mapping
   - Spatial Relations

K. Through the Air
   - Airplanes
   - Air Pressure
   - Astronomy

Section Two: Life and Health Science

L. Body Detective
   - Health
   - Human Body
   - Chemistry

M. Bones and Balance
   - Skeleton
   - Vertebrates
   - Human Anatomy

N. Fit n' Trim
   - Health
   - Genetics
   - Botany

O. Healing Techniques
   - Health
   - Anatomy
   - Circulation

P. Household Science
   - Food
   - Chemistry
   - Air Pressure

Q. Outdoor People
   - Wildlife Ecology
   - Animal Behavior
   - Biology

R. Pearly Gates
   - Teeth
   - Health
   - Spatial Skills

S. People Watchers
   - Sociology
   - Psychology
   - Anthropology

T. Pharmacy
   - Health
   - Biology
   - Chemistry

Section Three: Math, Calculating, and Computers

U. Chances Are
   - Probability
   - Sampling
   - Biology

V. Figures Don't Lie
   - Graphing
   - Sampling and Estimation
   - Data Interpretation

W. Information Manipulation
   - Computer
   - Classification

X. Program It
   - Computer
   - Logic

A *COMET Workshop Leaders Guide* is also available from COMETS, 205 Bailey Hall, Lawrence, KS 66045.

CONTACT:

Walter S. Smith
Curriculum & Instruction
205 Bailey Building
University of Kansas
Lawrence, KS 66045-2340
(913) 864-4435

TITLE OF PROGRAM:

Let Me See

SOURCE(S):

Produced by the Wisconsin Public Television Network through the facilities of the University of Wisconsin-Stout Teleproductions

AUDIENCE:

Students in primary grades

PROGRAM DESCRIPTION:

Based on the idea that science is not so much a body of information as a way of thinking and observing, *Let Me See* encourages children in grades one and two to use their powers of observation and reasoning to understand things and events in their daily lives. The series introduces scientific laws and concepts that can describe, explain, and predict events. Each program approaches a few main ideas in a number of ways. Animation, puppetry and dramatics, old movie footage, and sciences of everyday life help children predict how experiments will turn out or what will happen next in nature. Hocus the Crow and Pocus the clock, with their human friend Myrtle, demonstrate a method by which children can find facts on their own.

PRODUCTION DATE: 1982.

EVALUATION AND/OR COMMENTS:

Winner, NAEB Graphics Award for set design and Design Award for costume design, 1981; CPB Public Television Local Program Award, 1982, for program 10; CEN Certificate of Excellence, 1982; International Film and Television Festival of New York Bronze Award, 1982; 32nd Annual San Francisco State University Media Award, 1983; Ohio State Award, 1983. The *Let Me See* series was evaluated to assess the cumulative learning of objectives over the 12 weeks the programs were aired, as well as the effects from the instructional programs that had the series as a central focus. Subjects were first and second graders in 48 classes which viewed the series and 11 classes which did not. All classes were given a 20-item multiple-choice test both before and after the series was aired. Results indicated that classes at both grade levels that used the series gained significantly more than did the control classes in pre-test/post-test gain. Also related to post-test scores was time spent on supporting activities, particularly pre-activities and related activities other than discussion and learning center activities. (Webb, Norman L. *Summative Evaluation of Let Me See: An ITV Science Series for Grades 1 and 2*. Wisconsin Educational Communications Board, Madison, July, 1982. ED 228 990).

MATERIALS AVAILABLE:

Programs

Pendulums—Clocks and swings introduce the concept. Hocus and Myrtle investigate pendulums at home, and a magician demonstrates how they work.

Forces—Pocus reminds viewers that pushes or pulls make things move. Myrtle pushes and pulls and barbells, books, and chairs. Other glimpses of forces at work include examples to distinguish between balanced and unbalanced forces.

Magnets—Pocus shows that magnets can attract things and repel other magnets, even from a distance. Myrtle and Hocus determine whether a lodestone is a magnet and which of two magnets is stronger.

Sun—Pocus compares the brightness of sunny days in winter and summer, and contrasts seasonal temperature. Myrtle, the viewers, and animation help Hocus understand factors that affect temperature.

Air and Wind—Pocus demonstrates that air is real, takes up space, and moves objects. A TV Weatherman tells Hocus about the moving air particles in wind, which Pocus reminds viewers can be helpful or destructive.

Water and Rain—Viewers see examples of evaporation and Myrtle shows how water recycles. Pocus tells the story of Hilary, a water droplet. Hocus and Myrtle prepare to create a cloud.

Soil—When Hocus and Myrtle picnic on a rock, Myrtle predicts that over thousands of years, the rock will change to soil. Hocus learns how weather, plants, water, and animals make and move soil.

Ants and Worms—Pocus asks viewers whether earthworms are useful animals or pests. Myrtle digs them for fishing, and Hocus learns that both ants and worms mix plant and soil materials and help the soil hold air and water.

Plants—Pocus explains that plants make their own food. Hocus learns how dying and changing plants contribute to the plant cycle. Pocus asks viewers to plant some seeds to find out what makes them grow.

Insects—In Myrtle's garden, Hocus hears a cricket and learns that all insects have six legs, two antennae, and a three-part body. The program show how many different kinds of insects live and eat.

Birds—Pocus show how all birds are alike—they have feathers, two wings, a beak, and two legs and feet. As Hocus the crow's favorite book comes to life, the viewers see birds with different beaks, legs, wings, and feet—and what they can do differently.

The Pond—This program draws together concepts introduced in the series and establishes their interrelatedness. Myrtle, who is trying to catch a frog for a jumping contest, uses her magic animation to show Hocus changes that take place in a pond during the year. Pocus reminds viewers that living things depend on each other and that change is always taking place.

CONTACT:

Agency for Instructional Technology
Box A
Bloomington, IN 47402
1-800-457-4509

TITLE OF PROGRAM:

National Geographic Kids Network

SOURCE(S):

National Geographic Society (NGS), Technical Education Research Center, Inc. (TERC); funded by a grant from the National Science Foundation and Apple Computer.

AUDIENCE:

Grades 4-6

PROGRAM DESCRIPTION:

This hands-on curriculum involves students in conducting original research, using a computer to record data, and sharing their findings, via a modem and telecommunications, with "research teammates"—a group of geographically diverse classes in the United States, Canada, and other countries. A professional scientist on the network examines the data generated by the students and helps them look for geographic patterns in their findings. Classes send and receive data during prescribed six-week sessions for each unit. Each of the five units is "on-line" several times a year. To teach a Kids Network unit, a teacher must agree that his/her class will work simultaneously with the other classes on the network during one specific six-week session. Kits can be reused, but each use requires a new telecommunications subscription for every 30 pupils for a specific six-week lesson. Students gain experience in collecting and analyzing data, critical thinking, drawing conclusions, using computers to display information in the form of graphs and maps, letter writing, oral presentation, and map reading. Each unit meets several criteria. It must include an experiment that is interesting to students and addresses a problem that matters to students. The major experiment must fit into the network model, where need for substantial amounts of data requires the efforts of many student investigators. In addition, the unit looks for opportunities to address, in innovative ways, content areas typically part of the curriculum in grades 4-6, and to achieve good balance among the different sciences.

PRODUCTION DATE: 1989.

EVALUATION AND/OR COMMENTS:

This is a National Science Foundation Triad Program.

Over 4,000 classes around the U.S. and in over 30 foreign countries have purchased units in the first year and a half of publication.

The project received the 1990-91 Technology and Learning Software of the Year Award.

"Hello" and "Acid Rain" have received awards from the Los Angeles Unified School District, Media and Methods Magazine, and the State of California.

Textbooks and Education Software Services awarded KidsNetwork a high ranking.

An Apple IIGS computer with color monitor, a printer, and a model are needed to operate the programs. In the 1992 school year, an IBM version of the software will be available.

MATERIALS AVAILABLE:

Units

Hello—introduces students to scientific research methods, telecommunications, and the computer tools used in science and business today--wordprocessing, graphing, mapping, and data entry.

Acid Rain—students explore this important environmental issue, learning how to read the pH scale, how to use pH paper to measure acidity, design and build rain collectors, and measure the acidity of local rainwater.

Weather in Action—kids investigate local weather events and learn that weather is made up of different elements: temperature, wind, air pressure, and humidity. Classes set up weather observation stations, gather daily temperature readings, and observe sky conditions.

What's in Our Water—teaches about our single most important natural resource: water. Students learn about watersheds and the source of their school's tapwater, explore how substances get into our water, determine which substances might be considered "pollutants," observe how chlorine can retard the growth of microorganisms, and test tapwater for nitrate levels.

Too Much Trash?—students examine the composition and quantity of their trash, and what they can do about the trash problem.

Each kit contains a Tutorial disk that describes the Program disk functions; a comprehensive Teacher's Guide, including lesson plans and background; a concise Software Manual; full-color student handbooks; National Geographic wall maps; scientific materials as required; and reproducible activity sheets.

CONTACT:

To Order:

National Geographic Society
Educational Services
Dept. 5397
Washington, DC 20036
1-800-368-2728

For free preview kits, contact:

Karol Media
350 N. Pennsylvania Ave.
Wilkes-Barre, PA 18773-7600
(717) 822-8899

TITLE OF PROGRAM:

Project O.C.E.A.N. (Oceanic Classroom Education and Networking)

SOURCE(S):

Developed by Roberta Dean, Craig Strang, and Catherine Halverson, with a grant from the State Department of Education of California and the California Post-Secondary Education Commission.

AUDIENCE:

Students and teachers of elementary and middle schools (grades K-8)

PROGRAM DESCRIPTION:

This marine science education program is a staff development program, built on the belief that effective staff development not only trains teachers but that it also provides instructional materials and actual models of high-quality instruction—both within training sessions and on-site, within the school. In order to improve science and marine science teaching, teachers learn how to research, organize, and implement innovative science curriculum and instructional methods. Teachers and students gain marine science knowledge as well as overall science content and develop conservation ethics. Curriculum guides, which contain some student pages, are available. In addition to the curriculum guides, Project O.C.E.A.N. involves a school-wide immersion program, called Oceans Week, during which training of teachers continues directly (through workshops) and indirectly (through modeling of instruction by Project O.C.E.A.N. staff and other experts in marine science). The curriculum guides are also called habitat packets, and follow a systems approach to the study of marine science by examining in one habitat the integrated nature of physical science, biological science and human interactions with the marine environment. Packets contain detailed information about the habitat, thematic teaching "wheels" which show relationships among the three areas of study, instructional activities for each of the study areas, student project ideas, field trip information, and nontraditional evaluation techniques (over 120 pages of material for the teacher's use). A marine science education library is available at the Oceanic Society's San Francisco Bay Chapter. It contains reference books, audio-visual materials, posters, games and hands-on teaching aids, periodicals and reprints.

PRODUCTION DATE: 1985.

EVALUATION AND/OR COMMENTS:

Eighty-seven schools have used Project O.C.E.A.N. materials. Teachers have been individually interviewed and, using the interview data, case studies were developed focused on the school's level of participation, activities conducted, impact of Oceans Week on school climate and culture and on teachers and their students, and commitment to future Oceans Weeks in the school. Teacher questionnaires evaluating the habitat packets were also administered and results summarized. The project was found to be very effective in increasing the amount of science taught and in increasing teacher confidence in teaching marine science. Most important, it was found the project stimulated collegial behavior in all of the participating schools. Teachers reported that they shared materials and ideas, planned cooperatively, and worked with people who were not usually colleagues. (Estrin, E.T. and Lash, A.A. *The Effects of a Marine Science Curriculum and Training Project on Collegiality*. Paper presented at the Annual Meeting of the American Educational Research Association, San Francisco, March 27-31, 1989.)

MATERIALS AVAILABLE:

These activity-based guides illustrate physical science, biological science, and human interaction aspects of each habitat. The guides sell for $35 each, plus tax.

Habitat Packets (Guides)

Rocky Intertidal (Grades K-1)
Open Ocean (Grade 2)
Mudflats (Grade 3)
Kelp Forest (Grade 4)
Sandy Beach (Grade 5)
Bay/Estuary (Grades 6-8)

Also available is the Adopt-a-Beach Handbook. Additional materials that can bring marine biology into local classrooms have been made available.

CONTACT:

Ocean Alliance
Project O.C.E.A.N.
Fort Mason Center, Bldg. E
San Francisco, CA 94123
(415) 441-5973

TITLE OF PROGRAM:

Ranger Rick's NatureScope

SOURCE(S):

National Wildlife Federation

AUDIENCE:

Grades K-8 Educators

PROGRAM DESCRIPTION:

Nature Scope is an environmental education activity series and workshop program for K-8 educators. Its goal is to inspire in children an understanding and appreciation of the natural world while developing the skills they will need to make responsible decisions about the environment. The interdisciplinary activities promote group interaction, strengthen thinking skills, provide indoor and outdoor investigations, and incorporate a variety of learning and teaching styles. The workshop component is designed to help educators incorporate environmental education into their teaching and promote action on behalf of the environment.

PRODUCTION DATE: 1984.

EVALUATION AND/OR COMMENTS:

Since it was first published in 1984, *NatureScope* has received a number of national awards: Natural Resources Council of America's Best Educational Effort for 1984; 1987 Wyoming Field Science Foundation Award; 1986 National Arbor Day Foundation Education Award for *Trees Are Terrific*; 1988 Award for Outstanding Services to Meteorology by a Corporation from the American Meteorological Society for *Wild About Weather*; 1989 Award for Excellence in Education from *Media & Methods;* 1990 National Arbor Day Foundation Education Award for *Rain Forests: Tropical Treasures*; 1990 Environmental Achievement Award from Renew America's *Searching for Success* campaign.

NatureScope was also selected by Silver Burdett Publishing Company to be included in a *Best of Environmental Education* guide for elementary educators.

Three national surveys conducted by NWF have shown that educators use, value, and depend on *NatureScope*. Here are some of their comments:

"*NatureScope* is one of only a few programs available nationally that I would endorse as being of high quality and, at the same time, cost effective." Louis Tozzi, Chairman, Dept. of Education, Rutgers University, NJ

"*NatureScope* is one of the finest children's learning series I've seen yet. " Judy Gillan, Nongame Education Coordinator, Florida Game and Fresh Water Fish Commission

"*NatureScope* has made an excellent contribution in bridging the gap between the classroom and the natural environment." Joseph T. Howard, Supervisor of Outdoor Education Programs, Montgomery County (MD) Public Schools

"As an environmental education professional with over ten years of intensive experience in curriculum development and teacher training, I can say without reservation that *NatureScope* is one of the top projects in the

world." W. J. Rohwedder, Assoc. Prof., Dept. of Environmental Studies and Planning, Sonoma State University, CA

"This is the best organized and most exciting material for science I've seen in 20 years of teaching." Bobbie Little, Teacher, California

"It is rare to find a teaching tool designed for elementary education that includes both well researched content as well as highly motivating teaching techniques." Herb Broda, Asst. Supt. for Curriculum and Instruction, Wayne County (OH) Public Schools

"*NatureScope* is an extremely valuable resource to the educators I work with in zoos, aquariums, and natural history museums." Richard Block, Dir. of Public Programs, World Wildlife Fund

MATERIALS AVAILABLE:

Each issue of *NatureScope* focuses on a separate topic and contains up-to-date background information, hands-on activities that teach the concepts introduced in the background, ready-to-copy worksheets that supplement the activities, and an extensive bibliography. Each activity provides step-by-step instructions and lists objectives, age levels, materials, and subject areas.

Issues currently available:

Incredible Insects
Digging into Dinosaurs
Wild About Weather
Birds, Birds, Birds!
Discovering Deserts
Trees Are Terrific!
Astronomy Adventures
Amazing Mammals: Part I
Amazing Mammals: Part II
Wading into Wetland
Geology: The Active Earth
Endangered Species: Wild and Rare
Let's Hear It for Herps! (Reptiles and Amphibians)
Incredible Insects Discovery Pac
Diving into Oceans
Wild and Crafty
Rain Forests: Tropical Treasures
Pollution: Problems and Solutions

CONTACT:

NatureScope
National Wildlife Federation
8925 Leesburg Pike
Vienna, VA 22184-0001
1-800-432-6564

TITLE OF PROGRAM;

Ecosystems of the Great Land

SOURCE(S):

Alaska Department of Education and the Agency for Instructional Technology

AUDIENCE:

Junior high and high school students

PROGRAM DESCRIPTION:

Ecosystems of the Great Land consists of six 15-minute video programs designed to fit easily into any course for students from grades five or six through high school in which ecology is taught, such as biology, earth science, and geography. The videos may be used in sequence, or they may be used separately. Through a survey of the specific features of Alaska's four main ecosystems, the programs illustrate and emphasize fundamental concepts of ecology: web of life, food chain, habitat, carrying capacity, natural communities, adaptation, predator and prey relationships, plant succession, photosynthesis and energy transfer, and the water cycle.

PRODUCTION DATE: 1985.

EVALUATION AND/OR COMMENTS:

Winner, CINE Golden Eagles, 1986, for programs 2, 3, and 6; PMN Division of Learning Services Award, 1987, for program 2; Wilbur Schramm Award, 1987, for program 2. *Science Books & Films* (American Association for the Advancement of Science) notes: "Overall, the program is good and would best be used as a unit to introduce basic ecological concepts with the Alaskan environment as an example."

MATERIALS AVAILABLE:

Six video programs and a teacher's guide.

Video Programs

Introduction to Ecosystems—This program introduces the general ecological concepts, the role of sun, photosynthesis, and the web of life. It briefly describes the four major Alaskan ecosystems: the tundra, with lichens and small bushes, but no trees; the more populated and better watered taiga; the coastal forests with its rivers and bogs; and the oceans that surround Alaska.

The Tundra Ecosystem—This program considers the various adaptations made by plants and animals to the harsh environment. Arctic and alpine tundra together cover 166 million acres in Alaska. They support limited life because of moisture, dry winds, and little light. Temperatures range from 40° below to 115° above. Trees do not grow here, and the beginning of the tree line marks the taiga. The blooming flowers generally come in deep, brilliant colors that absorb heat, and may take 20 years to bloom. Damage to the tundra takes a long time to repair. Viewers see footage of mountains and foothills,, tiny arctic plants, and heavy-coated animals. Inupiat Eskimos have lived here 6,000 years; their Yupik cousins, 3,000 years.

The Taiga System—The taiga begins where trees can grow. It has a dry, cold climate with less temperature variation than the tundra. Bogs are common, but fire risk is high. Forest fires let young trees grow. Forest succession is shown through the life of the white spruce. The interdependence of the lynx

and hare and the fox and lemming illustrate carrying capacity and predator/prey relationships. Footage of the lynx helps viewers consider the range and movement of the predator.

The Coastal Forest Ecosystem—Extending 900 miles, the coastal forest has one of the highest rainfall levels in the world, with up to 222 inches of rainfall in a season. The continuous water cycle of evaporation, cloud formation, rainfall, and drainage is also examined. The program continues the discussion of forest succession and the difference between old and new growth forests. Animals in the ecosystem include black bears, grizzlies, martens, mink, otters, foxes, and wolves.

The Ocean Ecosystem—The source of weather and moisture for much of the world, the ocean is larger and contains more living things than the land. Ninety percent of all marine life is found on the continental shelf. Microscopic plankton, which provide half the world's oxygen through photosynthesis, are an indispensable part of the food chain. The program shows the journey Pacific salmon make to spawn and their bodies' role in the food chain. Other ocean animals include seals, walrus, polar bears, and whales.

Man's Impact on the Environment—Concepts introduced in the preceding programs are used in a discussion of how humans interact with the environment. In the tundra, the population threatens to damage the ecosystem. In the taiga, fire and floods, roads, railroads, and agricultural land are problems for the environment. The coastal forests recover best from human intervention because they receive the most energy from the sun, but logging affects salmon habitats. The program emphasizes that each system needs special care to keep its own natural balance.

Teacher's Guide

The guide contains a separate lesson for each of the six video programs. Each lesson contains a detailed program summary; student objectives; pre-viewing activities providing advance organizers, including a list of terms to be introduced in the video, post-viewing questions for thought and discussion; and a set of reproducible handouts for deskwork, including a crossword puzzle, a word search, and a quiz. The guide also contains extended activities, visual aids for overhead projection or reproduction, a glossary, and a list of further resources.

CONTACT:

Agency for Instructional Technology
Box A
Bloomington, IN 47402
1-800-457-4509

TITLE OF PROGRAM:

Exploring Technology Education

SOURCE(S):

Developed by a consortium of state and provincial agencies organized and managed by AIT.

AUDIENCE:

Middle school, junior high school

PROGRAM DESCRIPTION:

This video program series introduces four major technology systems and is designed to accompany the text series developed by the Mid-America Vocation Curriculum Consortium (MAVCC). The programs take viewers to places where technology is changing the way we work: (1) the headquarters of USA Today, where technology has changed how a newspaper is designed and produced; (2) Australia, where solar-powered cars race across the desert; and (3) underwater, where students in diving masks build structures to simulate conditions in space. *Exploring Technology Education* is designed to help build the technological literacy vital for current and future careers. The programs may be used separately or together.

PRODUCTION DATE: 1990.

EVALUATION AND/OR COMMENTS:

Winner, Silver Screen Award, U.S. Industrial Film and Video Festival, 1989, for program B1.

MATERIALS AVAILABLE:

Programs

About Exploring Technology Education (orientation program) contains excerpts from other programs explaining the importance of technology education.

A. Introduction to Technology

1. *Overview of Technology*—shows how developments of the past lead to those of the future.

2. *People, Technology, and the Environment*—considers the benefits and complex social and environmental problems technology brings.

B. Communications

1. *Introduction to Communication*—focuses on the impact of communication technology throughout history and presents the systems model (input, process, output, feedback).

2. *Designing Messages*—presents three steps for designing a message, demonstrates the elements of design, and visits *USA Today*.

3. *Producing and Transmitting Messages*—shows the role of computers in print at *USA Today*, and communication of the Live Aid concert by satellite transmission.

4. *Evaluating Messages*—illustrates the importance of feedback with shots of the SETI antenna, a collision of a plane with the Empire State Building, the Apollo 13 flight, Boy Scouts using modems, and a rock DJ.

C. Construction

1. *Introduction to Construction*—shows different types of construction, their development, and their relation to society and the environment. In an underwater construction project, students simulate conditions in outer space.

2. *Designing and Planning a Structure*—introduces design and planning processes.

3. *Building Safety*—shows the steps in preparing the foundation of a new house and processes in the construction of a new school.

4. *Finishing a Structure*—introduces subsystems (heating, cooling, plumbing, and electrical), and the processes, materials, and techniques needed to finish a structure.

D. Manufacturing

1. *Introduction to Manufacturing*—illustrates the evolution, development, and impact of manufacturing. Highlights Henry Ford's assembly line and techniques of the future.

2. *Manufacturing Systems*—introduces intermittent, continuous, and custom systems and their essential elements.

3. *Using and Evaluating Materials*—shows, with a violin, a human-powered aircraft, the space shuttle, and a laboratory testing running shoes, how the properties of materials are evaluated.

4. *Manufacturing Process*—introduces common and innovative processes. Production in a steel foundry and the handcrafting of a violin illustrate separation, forming, molding, conditioning, assembling,and finishing.

5. *Manufacturing Process Planning*—illustrates the roles of major divisions. Viewers visit a large plant that reorganized and adopted state-of-the-art technology to survive global competition.

E. Energy, Power, and Transportation

1. *Overview of Energy*—defines energy and shows its sources, forms, technological advances, uses, and impact on society and the environment. Considers exhaustible, renewable, and inexhaustible sources of energy.

2. *Conversion of Energy into Power*—demonstrates forms of energy, conversion of one form into another and all forms as sources of power.

3. *Transmission, Control, and Storage of Power*—shows a student-made version of a Hovercraft--and the four storage and transmission systems: mechanical, fluid, electrical, and thermal.

4. *Transportation Systems*—presents transportation systems and discusses the history and growth of transportation technology.

Teacher's guide also available.

CONTACT:

Agency for Instructional Technology
Box A
Bloomington, IN 47402
1-800-457-4509

TITLE OF PROGRAM:

Science Abled

SOURCE(S):

Produced by the University of Michigan School of Dentistry with a grant from the U.S. Dept. of Education, Women's Educational Equity Act (1987).

AUDIENCE:

Young people with physical and/or sensory disabilities, their teachers, counselors, and potential employers.

PROGRAM DESCRIPTION:

Two videotapes, *Good Minds at Work* and *Return on Equity*, make up the Science Abled program. *Good Minds at Work* is a 40-minute video program in career development for junior high, high school, and adult students. It features male and female scientists of various ethnic backgrounds, disabilities, and lifestyles as role models. A variety of science careers is represented: science teacher, computer programmer, psychiatrist, medical technologist, systems engineer, and chemistry professor. This video consists of two 20-minute segments, Work and Accommodations and Preparation for a Career in Science and Technology. Each can be shown separately, or together as one video. *Return on Equity* is a 30-minute video, intended primarily for potential employers. It presents the opinions of supervisors, coworkers, and other employees on the experience of working with disabled scientists. It also addresses many general concerns employers frequently have about hiring disabled persons. A comprehensive resource guide to each program includes biographical sketches of featured scientists and a list of organizations dealing with disability concerns. The guide for *Good Minds at Work* suggests discussion questions and supplementary activities. It also contains checklists for teachers, counselors, workshop leaders, and students, as well as a listing of information sources on disability concerns, science careers, and science organizations.

PRODUCTION DATE: 1987.

EVALUATION AND/OR COMMENTS:

Science Abled was winner of the Presentation Award, Superfest XV, Corporation for Disabilities & Communications, 1988 for *Return on Equity*.

MATERIALS AVAILABLE:

Two video tapes: *Good Minds at Work* (40 minutes) and *Return on Equity* (30 minutes); resource guide (one version for teachers, another for employers).

CONTACT:

Agency for Instructional Technology
Box A
Bloomington, IN 47402
1-800-457-4509

TITLE OF PROGRAM:

The Voyage of the Mimi

SOURCE(S):

Created by Bank Street College of Education with funding from the National Science Foundation and the U.S. Department of Education. Published by WINGS for Learning, a Sunburst company.

AUDIENCE:

Middle/junior high school and high school

PROGRAM DESCRIPTION:

Thirteen video episodes present the story of a research expedition aboard the Mimi to study whales off the coast of New England. Captain Granville and his 11-year-old grandson, C.T., and the rest of the crew learn about whales, ecosystems, computers, navigation, and maps during their adventures at sea. Thirteen documentary "expeditions" are paired with the video episodes and take students along on educational visits to the Smithsonian Institute, Woods Hole Marine Biological Laboratory, and other places where science is done.

PRODUCTION DATE: 1985.

EVALUATION AND/OR COMMENTS:

In an evaluation of the learning modules, microSIFT Course Ware Evaluation by the Northwest Regional Educational Laboratory reported a summary evaluation (with 5-High and 1-Low) as follows: Content - 4; Instructional Characteristics - 3; Technical Characteristics - 4. Evaluators indicated that they would use or recommend this package with little or no change.

MATERIALS AVAILABLE:

Videos

The six and one-half hour video collection is comprised of 26 15-minute programs: 13 dramatic episodes alternating with 13 related expeditions. Videos are close captioned in English and Spanish.

Print Materials

The Voyage of the Mimi: The Book, the student book, puts the story of the Mimi's adventures into the students' hands with original full-color art and photographs and includes student activities based on the themes covered in the episodes and expeditions.

Overview Guide, contains lessons and activities for each of the video segments to enrich and expand the Mimi experience along with two large wall charts—a navigation chart of the Gulf of Main and a poster of marine animals.

Learning Modules

Four learning modules contain software and print support materials with themes derived from the Mimi adventure:

Maps & Navigation—Helps students to understand both the two-dimensional world of maps and charts and the three-dimensional world of navigation.

Ecosystems—Introduces students to the elements of and relationships within ecosystems, with emphasis on food chains and webs.

Introduction to Computing—Traces the history of number systems and computing. Employs *Turtle Graphics* to introduce students to Logo and higher-level computing concepts.

Whales and Their Environment—Includes the *Bank Street Laboratory*, a combination of software and hardware that transforms the computer into a laboratory for gathering and displaying data about the physical world.

CONTACT:

WINGS for Learning
1600 Green Hills Rd.
Scotts Valley, CA 95067-0002
1-800-321-7511

TITLE OF PROGRAM:

The Second Voyage of the Mimi

SOURCE(S):

Created by Bank Street College of Education with funding from the National Science Foundation and the U.S. Department of Education. Published by WINGS for Learning, A Sunburst Company.

AUDIENCE:

Middle/junior high school and high school

PROGRAM DESCRIPTION:

This video series presents the adventures of Captain Granville and his first mate C.T. as they travel through Mexico to study the ancient Maya civilization. An archaeological research expedition turns into a mystery as the crew discovers a group of looters which involves them in a race to locate a "lost" ancient Maya city with challenges at every turn. Interspersed with the dramatic "episodes" are 12 "expeditions" in which cast members visit places where real science is done including the Monteverde Cloud Forest in Costa Rica, the North American Hyperbaric Center, and the Old Royal Observatory in Greenwich, England.

PRODUCTION DATE: 1988.

EVALUATION AND/OR COMMENTS:

Recipient of the 1990 Parents Choice Award and the 1990 Technology and Learning Award.

MATERIALS AVAILABLE:

Videos

The six-hour video collection is comprised of 24 15-minute segments. Each of the 12 dramatic episodes is paired with its related expedition. The videos are close captioned in English and Spanish.

Print Materials

The Second Voyage of the Mimi: The Book, the student book, tells the story of the Mimi's adventures with original full-color art and photographs and includes student activities based on the themes covered in the episodes and expeditions.

Overview Guide contains lessons and activities for each of the video segments to enrich and expand the Mimi experience along with two wall charts—a map of Mexico and a poster of a Maya archaeological site.

Learning Modules

Two learning modules contain software and print support materials with themes from the Mimi adventure:

Maya Math—Students work as "math archaeologists" to decipher the mysterious Maya number system. To succeed, they must articulate and apply their understanding of our own number system.

Sun Lab—In this Learning Module students study and explore the astronomy of the earth and sun. The module supports a rich and broad range of curriculum objectives spanning grades 4 through 8.

CONTACT:

WINGS for Learning
1600 Green Hills Rd.
Scotts Valley, CA 95067-0002
1-800-321-7511

TITLE OF PROGRAM:

WhatAbout

SOURCE(S):

This series was developed through the resources of a consortium of state and provincial agencies, organized and managed by AIT. It was produced under the management of AIT at the Walt Disney World resort complex, the Smithsonian Institution, Maryland Instructional Television, and various research facilities at the University of Arizona and nearby Mount Hopkins.

AUDIENCE:

Junior high school students

PROGRAM DESCRIPTION:

WhatAbout is a series of twelve 15-minute color video programs that helps seventh and eighth grades understand the nature of scientific inquiry and apply scientific processes to their own questions. In each program, viewers see someone their age use a scientific process in an everyday situation and a professional scientist using the same process.

PRODUCTION DATE: 1983.

EVALUATION AND/OR COMMENTS:

Joseph M. Morgan (University of Wisconsin) says "[WhatAbout] will do much to foster understanding and spur interest in scientific inquiry" (programs 7, 8, and 9). *Science Books & Films*, March/April, 1985. (American Association for the Advancement of Science)

MATERIALS AVAILABLE:

Programs

Questioning in Science?—A research horticulturist is making progress toward more salt-tolerant crops because he learned to ask the right question.

Hypothesizing in Science?—An agricultural scientist tests the hypothesis that the force of a spinning drum will have the same effect as gravity on growing plants in outer space.

Observing in Science?—A biologist uses special night-vision equipment to observe how bats pollinate tropical plants.

Measuring in Science?—An archaeologist uses measuring to reconstruct and understand the fossil remains of a mammoth.

Recording Data in Science?—A marine biologist records data about a coral reef in hope of learning to "farm" reefs for food.

Classifying in Science?—A curator classifies flamingos to ensure that a flock is correctly constituted for maximum breeding potential.

Inferring in Science?—A dendro-chronologist makes inferences about weather conditions in the past based on observations of tree rings.

Predicting in Science?—An astro-physicist predicts the discovery of a galaxy between the earth and the quasar he is studying.

Modeling in Science?—A geochemist creates a model of the Earth's interior by melting a piece of meteor in a special furnace.

Experimenting in Science?—A curator experiments to learn how insects can be kept alive in captivity.

Decision-Making in Science?—An ecologist helps plan land development without threatening red cockaded woodpeckers, an endangered species. A hydrogeologist explains how he advises communities on sites for waste disposal.

Communicating in Science?—Scientists communicate and test their procedures and conclusions with other scientists in the give and take of conferences and seminars, and by writing papers. Two science communicators explain how information reaches the general public through the popular press, television, and exhibits.

CONTACT:

Agency for Instructional Technology
Box A
Bloomington, IN 47402
1-800-457-4509

TITLE OF PROGRAM:

You, Me, and Technology

SOURCE(S):

Produced by New Jersey Network with support from the National Science Foundation for Temple University (Programs 1 and 2) and the University of Colorado at Denver (Programs 3-12).

AUDIENCE:

Junior high school, high school, and adult

PROGRAM DESCRIPTION:

This is a series of 12 video programs designed to be viewed separately, together, or in any sequence. A thirteenth program is designed to help teachers develop classroom activities. The four major objectives for the program are: (1) To develop technological literacy—that is, an awareness of the methods, structure, and general principles of technology. (2) To recognize the impact of technologies on society and the effects of social decisions on technologies. (3) To recognize that as society becomes more technological, only those who are technologically literate will be able to participate fully. (4) To develop an objective attitude toward technologies and to search for the tradeoffs between their costs and their benefits. Dramatic segments, archival footage, animated diagrams, interviews with scientists, and scenes in factories and hospitals present technology's impact on individuals and society's demands on technology.

PRODUCTION DATE:

Program 1-2 - 1982; Program 3-8 - 1986; Program 9 - 1987; Program 10-12 - 1989.

EVALUATION AND/OR COMMENTS:

Winner, Best Production in Video, Festival de Cinema, Barcelona, 1985, for Program 1; Distinguished Technical Communication Award, Society for Technical Communication, 1989, for Program 12.

MATERIALS AVAILABLE:

Video Programs

Living With Technology (consumerism) illustrates how our lives are touched by technological development and that daily decisions require responsible, informed decisions.

Decisions, Decisions, Decisions (information processing) presents flow chart showing that the steps in decision making are the same whether the input is processed by a machine, an electronic amplifier, or a human brain.

The Technology Spiral (four technology revolutions) "takes away" transistors, vacuum tubes, Thomas Edison, wheels, petroleum, and the industrial and agricultural revolutions as it spirals back to the first toolmakers.

Energy for Societies (alternative energy sources) presents investigations of advantages and disadvantages of coal, nuclear fission, trombe walls and photovoltaics, windmills, biomass, conservation, and cogeneration systems.

Health and Technologies (costs and benefits to society) presents questions raised by new medical technology.

Feeding the World (agricultural technologies) examines clearing of forests for farmland and expanding use of irrigation, pesticides, and fertilizers to increase food supply but which also lead to other problems.

Communications: The Expanding World (communications) presents the production of an imaginary news show by a high school journalism class to demonstrate the importance of communications and its progression from language, writing, and printing to the satellite and fiber optic technologies of today.

A Changing Romance: Americans and Wheels (transportation) examines several possible solutions to problems such as pollution, accidents, and traffic congestion associated with cars.

China, Japan, and the West (transfer of technologies) shows how technology, with such examples as the Chinese inventions of the compass, movable type, and gunpowder, can spread from one society to another and how the same technology can influence different cultures in different ways.

Population Patterns and Technology (rising birthrate, falling death rate) examines the relationships between technological changes and population patterns.

Exploring Space (benefits of space exploration) examines the applications of space technology for commercial and scientific uses.

Risk, Safety, and Technology (risk in a technological society) distinguishes between voluntary, involuntary, perceived, statistical, long-term, and short-term risk.

Printed Material

Teacher's guide (92 pages) contains general activities to introduce each program and follow-up activities which include integrated (multidisciplinary) activities, and activities specific to each of five content areas: science and technology, mathematics, social studies, English/communications, and vocational education. Transparencies for each program are also included along with additional resources and a textbook correlation bibliography.

CONTACT:

Agency for Instructional Technology
Box A
Bloomington, IN 47402
1-800-457-4509

Selected Promising and Exemplary Materials and Programs for High School

Adopt-A-Stream Program 68
ChemCom: Chemistry in the Community 69
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Interactions 74
The Mechanical Universe...and Beyond 78
Principles of Technology 82
Science Screen Report 84

TITLE OF PROGRAM:

Adopt-A-Stream Program

SOURCE(S):

Originally developed by Delta Laboratories, Inc., a certified, non-profit environmental laboratory dedicated to improving and protecting the environment; now maintained by the Adopt-A-Stream Program.

AUDIENCE:

Primarily High School; modified versions for Middle School (5-8) also available.

PROGRAM DESCRIPTION:

This is a community-based volunteer water quality monitoring program, developed as a way to involve both community and school in the improvement and preservation of local waterways. A school group and their faculty advisor will, in cooperation with a community cosponsor, "adopt" a local body of water, evaluate its condition, and work with the community to improve and beautify this waterway. This is an interdisciplinary, field-oriented program. The teacher needs to locate a waterway and identify a community cosponsor who will meet with students to demonstrate support for their efforts; help in the selection of an appropriate waterway and provide special information about it; guide students to the proper state, county, and town offices to learn the current classification and condition of the waterway; accompany the students on field trips; help prepare news releases and articles; and provide funds, if necessary. Delta Laboratories will help in enlisting a cosponsoring organization; publish a newsletter to provide communication among participants; make available a list of consultants who will help with particular questions; carry out no cost back-up laboratory testing; and advise participants in the process of continuing community activity to improve and maintain their waterway. There are now 139 program participants in 27 different states.

PRODUCTION DATE: 1986.

EVALUATION AND/OR COMMENTS:

Officially endorsed by the New York State Outdoor Education Association and by the New York State Conservation Council; implemented as a part of the public education efforts of the Portland (ME) Water District; and recommended by Ducks Unlimited.

MATERIALS AVAILABLE:

Adopt-A-Stream Program provides a teacher's handbook which includes instructions for all steps needed to "adopt" a stream or waterway: start-up, planning, equipment checks, safety, field sampling, lab analyses, data forms, data evaluation, report preparation, and extensive resource material.

CONTACT:

Linda Driscoll
Director, Adopt A Stream Program
3071 Chile Ave.
Rochester, NY 14624
(716) 426-4810

TITLE OF PROGRAM:

ChemCom: Chemistry in the Community

SOURCE(S)

Developed by the American Chemical Society .

AUDIENCE:

High school students

PROGRAM DESCRIPTION:

This year-long course is designed primarily for those who plan to pursue careers in fields other than science. Each of ChemCom's eight units centers on a chemistry-related technological issue now confronting our society and the world. The topic serves as a basis for introducing the chemistry needed to understand and analyze it. The content and flexibility of ChemCom is intended to aid the teacher wishing to teach chemistry that will apply immediately to all students; experience that will give them an understanding of the basic chemistry behind everyday phenomena such as soap or food additives as well as issues such as acid rain, nuclear power, and recycling. ChemCom is a chemistry text including the most traditional concepts and methods, for example, qualitative analysis, reactions, organic chemistry, gas laws, energy, and lab techniques such as titrations, distillation, and gas generation and collection, and calculations such as molarity and percentage composition. The material is presented in the context of the following units: Water, Resources, Petroleum, Food, Nuclear Chemistry, Air and Climate, Chemistry and Health, Chemical and Industry. Despite the nontraditional organization, principles are woven through a spiral approach that anchors knowledge and concepts in the real world.

PRODUCTION DATE: 1988.

EVALUATION AND/OR COMMENTS

The course was field-tested in the 1985-87 academic school year in 13 states by some 9,000 students. It was reported that "...many ChemCom pilot students express positive views about learning chemistry in light of their ability to apply the concepts, fact, and skills to everyday concerns and major issues confronting society." ChemCom has been adopted by eleven of the states among those that have some form of textbook adoption; it is listed as an approved/supplemental text in six states.

MATERIALS AVAILABLE:

Student text, teacher guides, standardized exam, ACS Newsletter, Computer Bulletin Board, user groups, and workshops.

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I. Supplying Our Water Needs

A. The Quality of Our Water
B. A Look at Water and Its Contaminants
C. Investigating the Cause of the Fish Kill
D. Water Purification and Treatment
Putting It All Together: Fish Kill in Riverwood—Who Pays?

II. Conserving Chemical Resources
- A. Use of Resources
- B. Why We Use What We Use
- C. Conservation in Nature and in the Community
- D. Metals: Sources and Replacements
- E. Putting It All Together: How Long Will the Supply Last?

III. Petroleum: To Build or to Burn?
- A. Petroleum in Our Lives
- B. Petroleum: What is It? What Do We Do With It?
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- D. Making Useful Materials From Petroleum
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- F. Putting It All Together: Choosing Petroleum Futures

IV. Understanding Foods
- A. Foods: To Build or to Burn?
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- D. Substances Present in Foods in Small Amounts
- E. Putting It All Together: Nutrition Around the World

V. Nuclear Chemistry in Our World
- A. Energy and Atoms
- B. Radioactive Decay
- C. Nuclear Energy: Power of the Universe
- D. Living With Risks and Benefits
- E. Putting It All Together: Separating Fact From Fiction

VI. Chemistry, Air, and Climate
- A. Life in a Sea of Air
- B. Investigating the Atmosphere
- C. Atmosphere and Climate
- D. Human Impact on the Air We Breathe
- E. Putting It All Together: Is Air a Free Resource?

VII. Chemistry and Health
- A. Chemistry Inside Your Body
- B. Chemistry at the Body's Surface
- C. Chemical Control: Drugs and Toxins in the Human Body
- D. Putting It All Together: Assessing Personal and Public Health Risks

VIII. The Chemical Industry: Promise and Challenge
- A. A New Industry for Riverwood
- B. An Overview of the Chemical Industry
- C. Nitrogen Products and Their Chemistry
- D. Chemical Energy—Electrical Energy
- E. Putting It All Together: The Role of the Chemical Industry Past, Present, and Future

CONTACT:

Kendall/Hunt Publishing
2460 Kerper Blvd.
Dubuque, IA 52001
1-800-258-5622

TITLE OF PROGRAM:

Concepts in Science

SOURCE(S):

Produced by Ontario TV with support from the University of the State of New York, the State Education Department, and the Assistant Commissioner for ESC Education Planning and Support Services.

AUDIENCE:

High school and college students

PROGRAM DESCRIPTION:

This collection of 17 mini series on concepts in science was specifically developed for use in biology, chemistry, and physics courses at the high school level. The programs were created in response to a comprehensive survey that asked teachers to identify the topics that posed the greatest difficulties. Each mini series of six 10-minute programs uses computer-generated animation and a humorous approach to present concepts in a clear, visual manner, and concludes with a brief summary of the material covered. A teacher's guide accompanies every Concept in Science mini series, providing additional information, learning objectives, detailed program descriptions, a wide range of before- and after-viewing activities for classroom use, and suggestions for further reading and research. All 17 mini series and their related publications are also available in French.

PRODUCTION DATE: 1989.

EVALUATION AND/OR COMMENTS:

1988 AMTEC Media Festival Panasonic Award for *Concepts in Science: Earth's Magnetic Field*; 1988 U.S. Industrial Film and Video Festival Silver Award for *Magnetism and Electron Flow*;" 1989 Ohio State Award for *Earth's Magnetic Field*; 1989 Houston International Film and Video Bronze Award for *Organic Chemistry 2*; 1989 U.S. Industrial Film and Video Certificate for Creative Excellence for *Organic Chemistry 2*; 1989 AMTEC Certificate of Merit for *Organic Chemistry 2*; 1989 Columbus International Film Honorable Mention for *Organic Chemistry 2*; 1989 GEMINI Nominated for Best Animated Program for *Organic Chemistry 2*; 1990 Video Rating Guide for Libraries Highly Recommended for *Cellular Respiration* and *Organic Chemistry 2*; 1990 Science Books & Films Highly Recommended for *Cellular Respiration*, and *Organic Chemistry 2*; 1990 Science Books & Films Highly Recommended for *Cellular Respiration*, *Electromagnetism*, *Organic Chemistry 1*, and *Organic Chemistry 2*.

MATERIALS AVAILABLE:

The videos consist of 17 series each containing six 10-minute programs. Teacher's guides are available for each series.

Biology

Cellular Respiration uses computer animation to illustrate some facets of cellular respiration, including glycolysis, the Krebs cycle, and oxidative phosphorylation.

Energy Flow studies the flow of energy throughout the world of living things and includes the process of photosynthesis, energy flow in organisms and in a cell as well as the energy flow in our agricultural system and in the biosphere.

Homeostasis explores the internal systems of balance and regulation in animals, illustrating how the body deals with stress, and copes with changing conditions such as high and low temperatures.

Organic Evolution traces the development of various theories of evolution beginning with the Biblical account of creation, then discusses Darwin, Mendel, the Hardy-Weinberg law, and more.

Photosynthesis uses three-dimensional computer animation to show the dynamic process of photosynthesis at the molecular level; starting with the historic discoveries of Priestley, Ingenhousz, and Senebier. The series examines the absorption of light by plants and follows the energy pathways to the production of carbohydrates and other organic materials.

Protein Synthesis deals with the importance of proteins as the building blocks of life and the fundamental role that protein synthesis plays in all living things.

Chemistry

Chemical Equilibrium uses analogy and computer animation to introduce the concepts of chemical reactions, exploring the theories of steady state, dynamic equilibrium, kinetic theory, reaction tendencies, and the equilibrium constant.

Electrochemistry is designed to introduce the basic concepts of electrochemistry by explaining the principles involved in the everyday battery and then illustrating the terminology and processes of electrochemical reactions, how half-cell potentials can be determined, and how electrochemistry is at work in the commercial Leclanche cell.

Electron Arrangement and Bonding explores the development of the atomic model by scientists such as Bohr and Rutherford, and relates their contributions to an understanding of the functions of electrons; illustrates various aspects such as energy levels, orbitals, charges, relative mass, bonding, and electron configuration.

The Mole Concept clarifies the concept of the mole as the ultimate "standard container" for directly comparing large numbers of atoms and opens the way for understanding reactions at the molecular level.

Organic Chemistry 1 examines the structure of carbon, the atom common to all living matter, and investigates the properties of carbon and some of its fascinating uses in fuels, plastics, and industry.

Organic Chemistry 2, a sequel to *Organic Chemistry 1*, uses sophisticated three-dimensional animation to show how the molecules and properties of compounds lend themselves to a wide variety of industrial applications; concludes with a program on the benefits and risks of synthetic compounds.

Physics

Electricity covers the fundamentals of electrostatics and current electricity designed to help students formulate images of abstract concepts such as charging objects by contact and induction, and concepts related to current electricity such as electrical charge, current flow, potential difference, and resistance.

Electromagnetism uses computer-animated programs to show how the scientific understanding of the Earth's magnetic field came about and explores this force from early experiments to the concepts of electromagnetic induction, the motor principle, generators, and transformers.

Nuclear Physics shows, step-by-step, how an interest in cathode rays led scientists to discover X-rays, then alpha, beta, and gamma radiation, and finally to explore the conversion of matter into energy.

Structure of the Atom explores the history and development of the model of the atom, from the hypotheses of early Greek philosophers to the wave-mechanical model of modern atomic physicists.

Wave Particle Duality traces the development of the various theories advanced to explain the behavior of light from the concepts of the ancient Greeks to the proven models of today.

CONTACT:

TVONTARIO
U.S. Sales Office
143 West Franklin Street, Suite 206
Chapel Hill, NC 27516
1-800-331-9566

TITLE OF PROGRAM:

Interactions

SOURCE(S):

Part of the Secondary Grades Science, Technology, and Society project developed by Wisconsin Public Television and funded in part by the National Science Foundation. Produced by Wisconsin Public Television Network through the facilities of WHA-TV.

AUDIENCE:

High school, teaching/professional development

PROGRAM DESCRIPTION:

The series is composed of twelve 30-minute programs, each comprised of a 20-minute student program preceded by a 10-minute teacher inservice segment; 12 computer programs; and six 30-minute teacher inservice programs. The industrial revolution, computerized farming, gene splicing, nuclear power—solutions to society's problem often create new problems and demand new decisions. The *Interactions* series aims to equip high school students to make these important decisions knowledgeably. To this end, the series explores how science and technology interact with five realms of society: attitudes and beliefs, economics, societal needs, personal needs, and politics. Student programs examine particular issues that illustrate these interactions. The 12 computer programs, which correspond to the student videos, give students an opportunity to apply decision-making skills in simulation activities. The 30-minute inservice programs help teachers approach science and social studies from the perspective of interactions among science, technology, and society.

PRODUCTION DATE: 1989.

EVALUATION AND/OR COMMENTS:

ALA's Booklist notes that "*Interactions* is a valuable supplement to secondary science curriculums." Science Books & Films says: "*Interactions* is an excellent program...The package is interestingly and professionally done, and it certainly addresses a legitimate need in the classroom."

MATERIALS AVAILABLE:

Student Programs (with teacher inservice segments)

Waste Management—Technology has helped to create our waste disposal problem and may help us solve it. Our disposal options are dumping, burying, burning, and recycling, and until now economics has favored burial in landfills. Interviews with experts and citizens involved in plans to put a large landfill near Rodman, New York, dramatize some of the political and scientific issues involved in waste disposal.

Robots—Cybernetics--the use of mechanical and electrical systems to replace humans--is a relatively new development dependent on the computer chip that permits miniaturization of power and control functions. In 1973 OSHA legislation requiring industries to protect workers from hazardous working conditions spurred the use of robotics in industry. Robots replaced workers, but many have had to learn to supervise robots rather than do the work themselves. Workers of the future will increasingly need to learn to do what robots can't do.

Superconductivity—The discovery of superconductivity using ceramics at temperatures considerably higher than absolute zero may have profound political and economic repercussions. The country that develops practical technological applications for the discovery will have a strong competitive advantage, especially in the areas of energy and transportation. There are also important medical applications.

Acid Rain—Acid deposition--much of it from power plants in the Midwest--results from an expanding economy, affluent lifestyle, convenient transportation, and plentiful energy, and it can damage lakes, forests, buildings, and artifacts--especially in the Northeast and Canada. The situation sets the East against the Midwest, and Canada against the U.S., both politically and economically. The chemistry of acid rain can vary and opinions about the nature and severity of the problem and the best way to deal with it diverge widely.

Energy—The demand for energy in the industrialized world is unprecedented, but the use of fossil fuels (coal and oil) causes pollution and depletes world resources. Nuclear power may be the best alternative, but it has a high cost, arouses widespread public opposition (especially since the accident at Three Mile Island), and leads to the problem of disposing of radioactive waste. Government planning and action will probably be necessary to balance issues of safety, risks, economics, politics, and attitudes, and develop alternative energy sources.

Food—Since World War II, the American diet has come to emphasize speed and convenience of preparation, and is affected by health concerns and marketing strategies. Fast foods, freezers, frozen foods, the increase in working women, and microwave ovens have brought about changes in processing, packaging, and distribution. Scientists turn to genetic engineering to increase farmers' production. U.S. eating habits have an international effect as beef for the fast food market is leading to loss of the rain forest, and freon gases in refrigerators may affect the ozone layer.

The Auto--The American passion for cars and the freedom they give us is extremely costly and wasteful of resources. The car has brought profound changes to women, rural people, and blacks. It has created suburbs and killed downtowns. Consumers demand economy, efficiency, convenience, and comfort. Robotics and computers have led to better designed, more reliable cars. More than any other technology, the economics of the car is tied to personal needs and strongly held attitudes.

Groundwater—We need water for every human activity, but our aquifers are in danger. We use far more than can be replenished by the natural process of recharge, and many people have found their wells or other sources of water contaminated by industrial or agricultural run-offs or landfills. The federal government regards water quality as a state or local concern, but water in the lowest aquifer can travel long distances. Technology is developing ways of sealing landfills and testing water, but cleaning up contaminated aquifers is expensive and not totally reliable.

Genetic Engineering—Manipulating the genetic code in plants and animals may lead to a revolutionary breakthrough in the technology of food production--developing cows with greatly increased milk production, plants that resist frost damage, and large quantities of other foods. If such genetic manipulation becomes common, some experts worry about the loss of biological diversity, cruelty to animals, economic disruption of the dairy and other markets, and the possibility of unforeseen, disastrous results.

Climate—Human activity is affecting the natural cycle of the Earth's climate. Carbon dioxide from the burning of fossil fuels is creating a possible "greenhouse effect." Climatic changes have enormous impact on our economics. Computer

models and satellites have improved our forecasts, especially for the very near future. The Global Climate Act of 1989 requires the government to develop a policy toward the suspected causes of global warming, but our knowledge is still very imperfect. Some possible solutions would be drought-resistant crops, reforestation, and a alternative energy sources.

Water—In the Southwest, much of the water is too saline for drinking or good crop growth, water purification is costly, and scientists are trying to develop salt-tolerant plants. The water needs of Los Angeles may leave surrounding areas with inadequate water. In the Northwest, the need to generate electrical power conflicts with the biological needs of salmon, the prosperity of the fishing industry, and the values and treaty rights of Native Americans. In Wisconsin, the paper industry's investment in expensive technology to keep rivers clean has not satisfied environmentalists, who claim that the waste water is still a health threat.

Wilderness—The United States was formed by its need to tame and exploit the wilderness, but since 1890 there has been no frontier. We have been insulated in a technological cocoon, but biologists, medical scientists, psychologists, ecologists, and climatologists understand the value of untouched nature. Programs such as Outward Bound are built on the character-building and the therapeutic effect of the wilderness. The fate of the wilderness depends on society's attitude. In a technological society, we need to manage our wild lands wisely.

Teacher Inservice Programs

Introduction (The Nature of Science and Society)—Defining science and technology and presenting excerpts from many student programs, this introduction shows how the United States thrives on technology, but few people understand how science and technology interact with society. Teachers discuss their experiences teaching science, technology, and society issues.

Attitudes and Beliefs—Creating, saving, prolonging, and destroying life have all come into the domain of modern science and technology, permitting the most personal parts of our lives to be affected by impersonal processes. Fertility problems, AIDS, and nuclear power are three issues involving strongly held attitudes and beliefs.

Economics—Science and technology have led to greater economic development, but economic forces also affect the allocation of resources to research. Agriculture, the coal industry in Illinois, magnetic resonance imaging in disease detection, and communications are technologies affected by economic issues.

Societal Needs—Computers, plastics, and antibiotics are examples of technological developments that were influenced by the needs of society during World War II.

Personal Needs—Our most basic needs--for food, water, clean air, and shelter--have been met so well by technology that we have come to develop new needs, reflecting a change in lifestyle and rising expectations. These in turn give rise to new technologies which, reinforced by marketing and advertising, again create new needs and put a severe strain on the world's resources.

Politics—Since World War II, the role of the government and military needs have often shaped the development of science and technology. Genetic engineering, acid rain, and regulation of hazardous materials are issues forcing lawmakers to reconcile differences and govern highly technical processes. Citizens will increasingly need to balance the knowledge given by science with human wisdom.

Two additional 30-minute inservice programs are available showing teachers using *Interactions* in their classrooms: "Teaching *Interactions: 'Acid Rain' and 'Genetic Engineering'*" and "Teaching *Interactions: 'The Auto' and 'Water'*."

CONTACT:

Agency for Instructional Technology
Box A
Bloomington, IN 47402
1-800-457-4509

TITLE OF PROGRAM:

The Mechanical Universe...and Beyond

SOURCE(S):

The Annenberg/CPB Project
P.O. Box 1922
Santa Barbara, CA 93116-1922

AUDIENCE:

High School and College

PROGRAM DESCRIPTION:

This is a 52-program series of video cassettes. Part I: 26 half-hour programs on 13 cassettes; Part II: 26 half-hour programs on 13 cassettes. The programs are also available on videodiscs. Intended as an introductory physics course, the programs combine state-of-the-art computer graphics with dramatic reenactments of great moments in the history of science. The videos trace the interaction of ideas from Aristotle to Einstein to explain the theories of such intellectual giants as Copernicus, Kepler, and Newton. The programs include classical mechanics, electricity and magnetism, relativity, waves and optics, heat and thermodynamics, and modern physics.

PRODUCTION DATE: 1985.

EVALUATION AND/OR COMMENTS:

Over 2,000 high schools in all fifty states are now utilizing an adaption of this resource material from the award winning PBS series. Rated as "highly recommended" by Science Books and Films.

ACCOMPANYING MATERIALS:

Part 1: 26 half-hour programs on 13 video cassettes. Part II: 26 half-hour programs on 13 video cassettes. Videodiscs: available for each part or containing both parts.

Part I

Introduction to the Mechanical Universe—Introductory preview introduces revolutionary ideas and heroes from Copernicus to Newton, and links the physics of the heavens and the earth.

The Law of Falling Bodies—Galileo's imaginative experiments proved that all bodies fall with the same constant acceleration.

Derivatives—The function of mathematics in physical science and the derivative as a practical tool.

Inertia—Galileo risks his favored status to answer the questions of the universe with his law of inertia.

Vectors—Physics must explain not only why and how much, but also where and which way.

Newton's Laws—Newton lays down the laws of force, mass, and acceleration.

Integration—Newton and Leibniz arrive at the conclusion that differentiation and integration are inverse processes.

The Apple and the Moon—The first authentic steps toward outer space travel as Newton discovers that gravity describes the force between any two particles in the universe.

Moving in Circles—A look at the Platonic theory of uniform circular motion.

Fundamental Forces—All physical phenomena of nature are explained by four forces: two nuclear forces, gravity, and electricity.

Gravity, Electricity, and Magnetism—Shedding light on the mathematical form of the gravitational, electric, and magnetic forces.

The Millikan Experiment—A dramatic recreation of Robert Millikan's classic oil-drop experiment to determine the charge of a single electron.

Conservation of Energy—According to one of the major laws of physics, energy is neither created nor destroyed.

Potential Energy—Potential energy provides a powerful model for understanding why the world has worked the same way since the beginning of time.

Conservation of Momentum—What keeps the universe ticking away until the end of time?

Harmonic Motion—The music and mathematics of periodic motion.

Resonance—Why a swaying bridge collapses with a high wind, and why a wine glass shatters with a higher octave.

Waves—With an analysis of simple harmonic motion and a stroke of genius, Newton extended mechanics to the propagation of sound.

Angular Momentum—An old momentum with a new twist.

Torques and Gyroscopes—From spinning tops to the precession of the equinoxes.

Kepler's Three Laws—The discovery of elliptical orbits helps describe the motion of heavenly bodies with unprecedented precision.

The Kepler Problem—The conduction of Kepler's laws from Newton's universal law of gravitation is one of the crowning achievements of Western thought.

Energy and Electricity—The precise orbit of a heavenly body--a planet, asteroid, or comet--is fixed by the laws of conservation of energy and angular momentum.

Navigating in Space—Voyages to other planets use the same laws that guide planets around the solar system.

Kepler to Einstein—From Kepler's laws and the theory of tides, to Einstein's general theory of relativity, into black holes, and beyond.

Harmony and the Spheres—A last lingering look back at mechanics to see new connections between old discoveries.

Part 2

Beyond the Mechanical Universe—The world of electricity and magnetism, and 20th century discoveries of relativity and quantum mechanics.

Static Electricity—Eighteenth-century electricians knew how to spark the interest of an audience with the principles of static electricity.

The Electric Field—Michael Faraday's vision of lines of constant force in space laid the foundation for the modern force field theory.

Potential and Capacitance—Benjamin Franklin proposes a successful theory of the Leyden Jar and invents the parallel plate capacitor.

Voltage, Energy, and Force—When is electricity dangerous or benign, spectacular or useful?

The Electric Battery—Alessandro Volta invents the electric battery using the internal properties of different metals.

Electric Circuits—The work of Charles Wheatstone, Ohm, and Kirchoff lead to the design and analysis of how current flows.

Magnetism—William Gilbert, physician to Queen Elizabeth I of England, discovered that the earth behaves like a giant magnet. Modern scientists have learned even more.

The Magnetic Field—The law of Biot and Savart, the force between electric currents, and Ampere's law.

Vector Fields and Hydrodynamics—Force fields have definite properties of their own suitable for scientific study.

Electromagnetic Induction—The discovery of electromagnetic induction in 1831 creates an important technological breakthrough in the generation of electric power.

Alternating Current—Electromagnetic induction makes it easy to generate alternating current while transformers make it practical to distribute it over long distances.

Maxwell's Equations—James Clerk Maxwell discovers that displacement current produces electromagnetic waves, or light.

Optics—Many properties of light are properties of waves, including reflection, refraction, and diffraction.

The Michelson-Morley Experiment—In 1887, an exquisitely designed measurement of the earth's motion through the Aether results in the most brilliant failure in scientific history.

The Lorentz Transformation—If the speed of light is to be the same for all observers, then the length of a meter stick, or the rate of a ticking clock, depends on who measures it.

Velocity and Time—Albert Einstein is motivated to perfect the central ideas of physics, resulting in a new understanding of the meaning of time and space.

Mass, Momentum, Energy—The new meaning of space and time make it necessary to formulate a new mechanics, therefore $E = mc^2$.

Temperature and Gas Laws—Hot discoveries about the behavior of gases make the connection between temperature and heat.

Engine of Nature—The Carnot engine, part one, beginning with simple steam engines.

Entropy—The Carnot engine, part two, with profound implications for the behavior of matter and the flow of time through the universe.

Low Temperatures—With the quest for low temperatures came the discovery that all elements can exist in each of the basic states of matter.

The Atom—A history of the atom, from the ancient Greeks to the early 20th century and a new challenge for the world of physics.

Particles and Waves—Evidence that light can sometimes act like a particle leads to quantum mechanics, the new physics.

From Atoms to Quarks—Electron waves attracted to the nucleus of an atom help account for the periodic table of the elements and ultimately lead to the search for quarks.

The Quantum Mechanical Universe—A last look at where we've been and a peek into the future.

MATERIALS AVAILABLE:

For Non-Science Majors: *The Mechanical Universe: Introduction to Mechanics and Heat (Part I)*, by Richard P. Olenick et al., Cambridge University Press, NY, 1986; *Beyond the Mechanical Universe: From Electricity to Modern Physics (Part II)*, by Richard P. Olenick et al., Cambridge University Press, 1986; *The Mechanical Universe: Trigonometry Primer and Student Study Notes (Part I)*, by Tom M. Apostol and Dave A. Campbell, Kendall/Hunt Publishing Co., Dubuque, IA, 1986; *Beyond the Mechanical Universe: Student Study Notes (Part II)*, by Dave A. Campbell, Kendall/Hunt Publishing Co., Dubuque, IA, 1986.

For Science and Engineering Majors: *The Mechanical Universe: Mechanics and Heat, Advanced Edition (Part I)*, by Steven C. Frautschi et al., Cambridge University Press, 1986.

CONTACT:

The Annenberg/CPB Project
P.O. Box 1922
Santa Barbara, CA 93116-1922
1-800-LEARNER

TITLE OF PROGRAM:

Principles of Technology

SOURCE(S):

Cooperative activity of a consortium of 43 states and provincial vocational education agencies in association with the Agency for Instructional Technology (AIT) and the Center for Occupational Research and Development (CORD). It is based on the Unified Technical Concepts course developed by the Center for Occupational Research and Development, Waco, Texas.

AUDIENCE:

Secondary school students: primarily tenth, eleventh, and twelfth graders interested in technical careers, and other students who wish to satisfy a science requirement with a course other than traditional science. Students should have at least an eighth grade reading ability and have satisfactorily completed one year of secondary-level general mathematics. Students will be helped by previous or concurrent enrollment in algebra.

PRODUCTION DATE: 1986.

PROGRAM DESCRIPTION:

Principles of Technology consists of 14 units of instruction spread over a two year period. Students must complete year one before enrolling in year two, although year one can stand alone as a one-year course. Each unit contains 26 lessons of 50 minutes each. Each of the 14 units deals with one principle as it applies in the four energy systems: mechanical, fluid, thermal, and electrical, that make up both simple and complex technological devices and equipment. The units also cover the mathematics needed to understand and apply the principles. Units, in order, in year one are on force, work, rate, resistance, energy, power, and force transformers. Year two begins with momentum, followed by waves and vibrations, energy convertors, transducers, radiation, optical systems, and time constraints. Each unit begins with an introduction and overview. The last class in each unit is a unit review/summary and test. The 24 intervening lessons are divided into four subunits of six classes each. A subunit consists of two days of lecture/discussion, a math skills lab, two days of hands-on physics application labs, and a subunit review. Video segments are used throughout. Facilities needed are a standard classroom plus adequate workspace to set up one to five lab stations per class. Also needed is a videocassette player (1/2" beta, 1/2" VHS, or 3/") and color monitor. Schools will need to purchase whatever laboratory and demonstration equipment is not already at hand. To fully equip a lab station for year one will involve $4000 to $6000. Teachers for this course need to be familiar with the physics and mathematics content of the course. They can come from the vocational technical faculty, from the science/mathematics faculty, or the school may set up a team with one teacher from each area.

EVALUATION AND/OR COMMENTS:

Drafts of print materials and scripts of audiovisual components were reviewed for content by an independent, eight-member team of specialists in vocational education and instructional media. Materials have also been reviewed by consortium agencies. Some 60 vocational schools throughout the United States and Canada have tested the units. All materials were extensively field-tested and appropriately revised.

Winner, AECT Industrial Training and Education Division, Certificate of Merit, 1987, for program 7; CINE Golden Eagle Award, 1987, for program 7; Certificate of Merit, INTERCOM—The Industrial Film and Video Festival, 1987, for unit 11.

MATERIALS AVAILABLE:

For each unit there is a comprehensive student text and a teacher's guide. There are approximately 78 video programs totaling about 500 minutes. The teacher's guide includes 50 demonstrations using readily available apparatus. The student text includes over 100 hands-on laboratories. The text also includes evaluation items and written exercises.

Units

Year One

1. Force
2. Work
3. Rate
4. Resistance
5. Energy
6. Power
7. Force Transformers

Year Two

8. Momentum
9. Waves and Vibrations
10. Energy Converters
11. Transducers
12. Radiation
13. Optical Systems
14. Time Constraints

Other Materials

Teacher"s guide for each unit; student's guide for each unit; and implementation notebook.

Information program of 15 minutes: "About Principles of Technology."

CONTACT:

Agency for Instructional Technology
Box A
Bloomington, IN 47402
1-800-457-4509

TITLE OF PROGRAM:

Science Screen Report

SOURCE(S):

Produced by Allegro Film Productions with the cooperation of the National Science Teachers Association and the Accreditation Board for Engineering and Technology.

AUDIENCE:

High School students

PROGRAM DESCRIPTION:

The *Science Screen Report* is a series of videotapes and accompanying teachers' guides for classroom use. The series covers chemistry, physics, biology, medicine, the environment, engineering, and other technological subjects. The series consists of seven 13- to 15-minute programs during a school year. The videotapes treat their subjects objectively, acknowledging societal problems such as acid rain and waste and then focusing on what is being done to solve the problems. The videotape series is free to school systems. Almost 300 corporate sponsors underwrite the series, which they donate to schools in cities where the corporations operate.

PRODUCTION DATE: 1988.

EVALUATION AND/OR COMMENTS:

The series has been distributed to about 2500 school districts nationwide, and in Canada and Puerto Rico. *Science Screen Report* has been recommended to receive the CMA's "stamp of recognition" as an educational program that will contribute significantly to public understanding of chemicals and chemistry.

MATERIALS AVAILABLE:

Videotapes (Topics for 1988-1989 school year):

Insects and Biology (Part 1)
Insects and Chemistry (Part II)
Energy From the Sun
The Science of Robotics
Nuclear Waste Management
Saving America's Wildlife From Extinction
The Biology of Water
New Insights From Plant Biology

Teachers' Guides:

A teachers' guide accompanies each tape and includes a glossary of terms, study questions, a bibliography, and a list of career opportunities.

CONTACT:

Science Screen Report
Allegro Film Productions
1000 Clint Moore Road
Boca Raton, FL 33487-2806
(407) 994-9111 or 1-800-232-2133

Selected Promising and Exemplary Materials and Programs for Advanced High School or College

Planet Earth 86

TITLE OF PROGRAM:

Planet Earth

SOURCE(S):

The Annenberg/CPB Project
P.O. Box 1922
Santa Barbara, CA 93116-1922

AUDIENCE:

College Level

PROGRAM DESCRIPTION:

This 7-hour series of video programs presents a tour of the planet with Nobel-Prize-winning scientists as they discuss discoveries in geoscience. Topics include plate tectonics, the oceans, climate, earth's energy and mineral sources, the solar sea, and new theories about the global consequences of a "nuclear winter" and an "ultra-violet spring."

PRODUCTION DATE : 1986.

EVALUATION AND/OR COMMENTS:

This Emmy Award-winning series was broadcast on PBS and referred to as "Good watching and good learning," by *Science Digest*.

MATERIALS AVAILABLE:

Available in two versions: 7 one-hour video programs on 7 cassettes or 14 half-hour programs on 7 cassettes. Also available is the Textbook/Study Guide: *Planet Earth and the New Geoscience* by Victor Schmidt, Kendall/Hunt Publishing Co., 1985.

Video Programs

The Living Machine—Plate tectonics, one of the most important discoveries of the 20th century, is explored with world-renowned scientists on location.

The Blue Planet—Major new revelations about the sea are presented by scientists aboard the space shuttle and diving in the depths of the "middle ocean" to view rare life forms.

The Climate Puzzle—Follow the clues that have helped scientists piece together an unfolding mystery—what caused the ice ages, how Venus's greenhouse effect may have parallels on Earth, and what America's eerie ice rivers demonstrate.

Tales From Other Worlds—Through little-seen footage shot in space and special effects, visit the great failed stars of Jupiter, probe the raging volcano of Io, and peer through acid rain clouds to see the surface of Venus for the first time.

Gifts From Earth—What treasures lie hidden beneath the Red Sea and Antarctic ice cap? By examining the earth's mineral and energy sources, scientists analyze how the theory of plate tectonics has revolutionized the search for earth's riches.

The Solar Sea—Geologists investigate an 800-million-year-old rock record of sun activity in an ancient Australian lake bed, and fabulous ground and satellite photography of the aurora borealis all contribute to an understanding of earth's relationship to the yellow dwarf star we know as the sun.

Fate of the Earth—New theories about the global consequences of a "nuclear winter" and an "ultra-violet spring" are revealed in this final episode that explores the role of life in shaping earth and its future.

CONTACT:

The Annenberg/CPB Project
P.O. Box 1922
Santa Barbara, CA 93116-1922
1-800-LEARNER

Summary

The generalizations and comparisons that follow are based on the information and materials that were available at the time the project was underway. The possibility always exists that additional materials, and information, exist elsewhere that might cause different comparisons to be made. Numerous attempts were made, during this two-year project, to obtain as much information as possible and we are grateful for the persons associated with the various programs who were willing to dig into their files and share information with us.

This is a diverse collection of exemplary programs, developed by a variety of individuals and groups in different locations. Nevertheless, as the information that appears in this document was reviewed, some common characteristics across programs and materials were identified.

Many of the programs and materials emphasize interdisciplinary teaching. Science is integrated with mathematics, with social studies, with language arts, with art. Many of the programs and materials appear to have been designed to change students' attitudes rather than to emphasize the accumulation of discrete pieces of information although science concepts and principles were part of the lessons. The focus in many programs and materials is on societal problems, the influence of technology on daily activities that students take for granted, and on emphasizing the interrelationship of science, technology, and society.

Several programs emphasize the use of cooperative learning activities with science students. Many program descriptions appear to emphasize active learning by students - carrying out laboratory activities, working at field sites, monitoring water quality of a local stream, studying the impact of people on the environment. Several program descriptions emphasize that the activities that are part of the program are designed to help students develop problem solving skills, to focus on learning to think critically as students investigate problems. Several programs appear to emphasize awareness on the part of students: of the contributions of famous scientists, of careers open to underrepresented groups of science careers for persons with physical disabilities, of the complexity of environmental relationships, and of the science principles upon with technology is based.

Although hands-on activities and active student involvement are part of most programs, many of the programs described in this document make use of video materials. At least 16 programs are primarily video: videotapes, video cassettes, video disks. Such materials enable students to see science demonstrations that most teachers could not easily perform in their classrooms, to watch the recreation of important episodes in the history of science, to see graphical illustrations of chemical reactions, etc. In fact *Concepts in Science* is a collection of videos that illustrate topics science teachers nominated as difficult for students to comprehend. This series includes such concepts as the Krebs cycle, photosynthesis, the mole concept, and electrostatics and current electricity.

Computers are also extensively used in several of the programs found in this publication. The National Geographic's Kids Network project links students all across the country, as well as in foreign countries, in a computer network to share data on a common investigation.

Because much concern has been expressed about the lack of science in the elementary grades, it was heartening to see that four of the programs nominated as exemplary began in the early grades and extended, in most cases, into high school. In addition, ten of the programs began with kindergarten or the primary grades and continued through grade eight. Eleven of the science programs were described as being aimed at middle or junior high school students, with some of these continuing into the senior high school years and a few being identified as appropriate, with some modifications, for elementary students. Only six of the programs identified

here are designed for high school, or older, students. One additional program is designated for college students but it probably could be appropriate for some advanced high school science courses whose content involved geoscience topics.

A characteristic that tied many of the exemplary science programs together was the fact that these programs were developed by organizations or groups involved in informal science education. Several programs were begun, and are available from, the Lawrence Hall of Science. The National Wildlife Federation and other groups concerned with the environment played an active role in the development of several programs and their related materials. A few programs appear to have been developed by a school system or a group of dedicated teachers within a single system who share an interest in a topic, such as marine science.

Earlier in this section, the fact that many programs appear to have been developed to change attitudes was identified. In addition to changing the attitudes of students in the public schools, several programs also want to sensitize the community the school serves to the interrelationships of science, technology, and society. At least three programs (*Adopt-a-Stream, CEPUP, and Project CLASS*) emphasize community involvement.

A number of years ago the National Science Teachers Association produced a report entitled "The Teacher is the Key" in (*Science Education: Accomplishments and Needs*, pp 47-60, December 1978, ED 171 571). The authors wanted the title to emphasize the fact that no matter how diligently curriculum reformers produced new science programs and materials designed to change the way science is taught, the individual classroom teacher's use of these materials determined the kinds of science experiences available to students. Therefore, when the programs were reviewed for this project, it seemed important to identify if staff development activities or inservice education in some form was part of the package. The concern for staff development was not universal across the programs. Some programs, such as *Project WILD* and *Project CLASS*, mandate teacher participation in a six-hour workshop in order to receive the materials. *Science Quest*, one of the few programs developed by a school system, has an extensive emphasis on staff development along with program development. One video series, *Interactions*, has a 10-minute segment of each videotape that provides teacher inservice before presenting the 20-minute segment for students. In addition, six 30-minute teacher inservice programs are designed to help science and social studies teachers approach their subjects from the perspective of interactions among science, technology, and society. A number of the other programs include teacher's guides as part of the program package, along with lesson plans and supplementary materials.

Although this project became more time consuming and labor intensive than anticipated at the onset, it has resulted in a collection of programs and materials that show promise for improving science education in America's schools.

Selected Information Sources

Agency for Instructional Technology
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800-457-4509

American Association for the Advancement of Science
1333 "H" St, NW
Washington, DC 20005
(202) 326-6400

EPIE Institute
103 W. Montauk Highway
Hampton Bays, NY 11946
(516) 728-9100

National Academy Press
2101 Constitution Ave., NW
Washington, DC 20418
(202) 334-3313

National Diffusion Network
555 New Jersey Avenue, NW
Washington, DC 20208-1525
(202) 219-2134

National Science Foundation
Division of Materials Development,
Research and Informal Science Education
1800 G Street, NW
Washington, DC 20550
(202) 357-7536

National Science Teachers Association
1742 Connecticut Avenue, NW
Washington, DC 20009
(202) 328-5800

Northwest Regional Educational Laboratory
101 Southwest Main Street - Suite 500
Portland, OR 97204
(503) 275-9500

R. R. Bowker
245 West 17th St.
New York, NY 10011
(212) 645-9700

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